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RESEARCH AND DEVELOPMENT EFFECTIVENESS PROGRAM 1969 (RDE 69)

A MANAGEMENT TOOL TO ALLOCATE THE BUDGET OF A RESEARCH ORGANIZATION

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WRIGHT-PATTERSON AIR FORCE BASE, OHIO

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JAMES F. BITTLE, II

FOREWORD

This report has been prepared by Robert R. Jurick and James F. Bittle, II of the Digital Computation Division, Directorate of Computation Services, Deputy for Engineering, Wright-Patterson Air Force Base, Ohio. It consists of information necessary to use the RDE69 computer program written for the Plans group of the Air Force Flight Dynamics Laboratory at Wright-Patterson Air Force Base, Ohio. This group, charged with development and implementation of the program, is comprised of Mr. A. B. Nutt, Mr. J. F. Schmidt, and Lt M. D. Rusk. The RDE69 programming effort began in August 1967. This report was submitted by the authors on April 19, 1968.

This technical report has been reviewed and is approved.

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ABSTRACT

A formulation and digital computer program is presented as a management tool to allocate the budget of a research organization. It has been designed to meet the specific needs of the Air Force Flight Dynamics Laboratory at Wright-Patterson Air Force Base, Ohio, but instructions are included to enable the program to be used by any research organizations. The value of a specific research task is defined and an optimization technique is employed to maximize the total value achieved for a given yearly budget constraint of the organization. A maximum of 250 research tasks may be considered. The program performs a yearly optimization for up to five years. It generates a number of reports which indicate the progress of each research task during the given time period and the effect of this progress on other organizational entities.

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VARIABLE NAMES AND SYMBOLS

VARIABLE	FORTRAN NAME	DESCRIPTION
b_j	BJ	Contribution of task to system j
b'_j	BP	Adjusted b_j from equations (2a) and (2b)
$\bar{b}_j$	CAVG	Average contribution of all tasks to system j
B_k	BPSUM	Total system contribution for a given task
c_j	CJ	AFFDL designated weight of system j
C_k	COST	Cost of resource level k for a given task including converted engineer costs
CENG	CENG	Cost of employing one engineer for one year
CL	CLY	Confidence level at end of preceding year
CL'_k	CLNU	Confidence level attainable if RL_k funds are used
CLH	CLH	Confidence level array for years preceding first year of optimization
CS_k	CS	Contract and support funds used at RL_k
d	AR	Ranking factor in value coefficient equation
D_n	DN	Number of tasks in division n
EC_k	EC	Contract engineers used at RL_k
EI_k	EI	In-house engineers used at RL_k
g_j	TG	Contribution of task to tech objective j
h_j	HK	AFFDL designated weight of tech objective j
R	IR	Rank of task within its division
RL_k	NRL	Resource level k for a given task

VARIABLE NAMES AND SYMBOLS (CONT'D)

VARIABLE	FORTRAN NAME	DESCRIPTION
RDE_k	OBJ	Value coefficient for RL_k
t_j	TBJ, TGK	Expected time-to-completion for systems or tech objective as determined by AFSC
T_k	TGSUM	Total tech objective contribution for a given task
$\mathcal{T}_{k,j}$	TIM	Timeliness factor of value coefficient equation
y_k	T8	Time in years for task to reach a confidence level of .8

SECTION I
INTRODUCTION

The Research and Development Effectiveness program (RDE) is designed to optimize the selection of tasks to be funded in a scientifically oriented organization which is constrained to a limited budget. It has been developed to meet the needs of the Air Force Flight Dynamics Laboratory (AFFDL) at Wright-Patterson AFB, Ohio; however, this documentation has been prepared to satisfy the interest shown by private industry and other Air Force agencies.

The problem of objectively allocating applied research resources within a large laboratory has basically two components: (1) the estimation of the potential value of an advancement in the state of engineering technology; (2) the alternative ways and costs associated in making this advancement. The research manager's function is to continually make choices among a large number of ways to spend resources. He must decide (1) what projects and tasks should be funded; (2) what rate of funding should apply; (3) whether the effort should be in-house or contract. Prior to the use of this program the allocation decisions were often the result of a loose interaction between requirements based on need, priorities as assigned by higher headquarters, and notions of costs and diminishing returns based on experience.

One often-used method of allocating resources is to list the possible projects in order of priority and then to fund each project successively until no more resources are left. This method often results in low cost projects of relatively low priority being ignored. Such a method has also another fundamental weakness in that it is very difficult to say just what level of funding is enough for any particular project. Fortunately it is possible to devise criteria for task selection which incorporate measures of both value and cost. Often it is not easy to develop these measures of cost and benefit objectively. Furthermore, it is humanly impossible for one individual to perform simultaneous evaluations of a multitude of competing projects. And a nonsimultaneous comparison, for example, may result in the allocation of resources on something very close to a first come , first served basis.

In light of the above problem, in 1962 the Chief of the Aeromechanics Directorate, Aeronautical Systems Division, assigned Capt. Robert H. Rea, in the Plans Office, to look into the possible ways that allocations of resources might be accomplished. During the course of his studies and investigation, he obtained the assistance of Lt. Thomas W. Synnott, an instructor in economics in the Department of Systems Management, Air Force Institute of Technology. Lt. Synnott suggested the use of Mathematical Programming as used in Capital Budgeting Problems, as described in a Doctoral Dissertation by H. Martin Weingartner. A linear programming approach was applied, a mathematical model was developed, and a trial run was made in 1964 - 65 for the FY 65 program. Each subsequent year improvements and changes have been made to the model, input data, and output formats. Beginning in 1965 (RDE66 program), the M40 linear programming routine was used in the solution of the allocation problem. In 1968 (RDE69 program) the linear program was abandoned in favor of a simplified program because, due to severe budgetary limitations, a single critical variable expressed in dollars was found to be adequate. The ratio of objective function (or merit factor) divided by cost in dollars is used as a ranking function.

The above, regardless of solution method employed, carries the basic objective of providing a decision aid for the Laboratory Director in utilizing the resources of the Air Force Laboratory in an effective manner.

The remainder of this report is composed of three parts; mathematical formulation, description of input and output, and a programming guide. Section II is intended to familiarize the user with the mathematical and logical structure of the program. A complete understanding of this section is necessary before the program can be expected to produce meaningful results. In addition, a thorough knowledge of the formulation is required before changes to the code can be attempted.

Section III describes in detail the preparation of the input data cards.

Finally, Section IV contains complete program documentation, and is supplied so that the user may easily tailor the program to his specific needs. In order that the program be essentially machine independent, the bulk of the code is written in FORTRAN.

Although this report is intended to be primarily a programmer-user manual, Appendix I is included to show how the input information is obtained from the project engineers. "Format I," which the engineer fills out, is then translated to AFFDL Form 15 which is the computer input form. Appendix II contains a sample FORMAT I for task 134702. This task is then used as the example task for all reports.

SECTION II
MATHEMATICAL FORMULATION

1. DEFINITIONS OF TERMS

- 1498 WORK UNIT - An individual effort within a task.
- CONFIDENCE LEVEL - A measure of the progress of a task. Its range is from .2 to .8 with the effort necessary to achieve each even-tenth being defined by the task engineer.
- DIVISION - The largest sub-organization of the Flight Dynamics Laboratory. The five divisions of AFFDL are:

  (1) Structures
  (2) Flight Mechanics
  (3) Flight Control
  (4) Vehicle Dynamics
  (5) Vehicle Equipment

- FACILITY - A test or support facility such as a wind tunnel or digital computer.
- PROJECT - A group of tasks that cover a given technical area within a technical domain (division).
- RESOURCE LEVEL - A description of the funding level of a task. A task is funded at resource level one if it receives its requested contract and support funds. A task is funded at resource level two if it receives the contract and support funds associated with double engineering manpower.
- SYSTEM - An AFSC approved system such as anti-ballistic missile or AMSA.
- TASK - A subdivision of a project. It is the basic funded element of AFFDL.
- TECHNOLOGICAL OBJECTIVE - An approved goal of a division such as better instrumentation or improved reliability for a given function.

- VALUE COEFFICIENT - A number associated with each resource level of each task. It represents the tasks contribution to the overall effectiveness of AFFDL at a given resource level.

2. PROBLEM DESCRIPTION

The management problem of obtaining maximum production for a given capital outlay becomes more complicated when the product is as intangible as technology. How is maximum technology output measured? How can the progress of one scientific effort be predicted when it is dependent upon the progress of many other scientific efforts? What is a basic unit for measuring technology?

The organizational structure of AFFDL satisfies the requirement for a set of basic technology activities. AFFDL is composed of five divisions with each division responsible for several exploratory development projects, each of which is subdivided into a set of tasks. The task is the smallest documented effort element of AFFDL that receives a defined budget and, therefore, it becomes the basic element of the optimization problem. The input to any task is dollars and manpower, and the output is the value of the attainment of its defined technological objective in a timely manner.

The value associated with a given task at a given time is dependent upon its support of officially defined Air Force Systems Command (AFSC) proposed systems or subsystems and technological objectives. The value of a task is also dependent upon the present state-of-the-art in its technical area and its predicted rate of progress. The total value of the AFFDL program is the sum of the values of its individual tasks. Because the budget is limited, it must be divided among the tasks in such a way as to maximize the total value of the AFFDL program.

The cost-effectiveness of a task is defined as the ratio of value received to money spent. Three choices of funding are possible for each task; (1) funds requested by task engineers, (2) funds necessary to perform the task with twice the requested manpower, and (3) no funds. Choices 1 and 2 are called resource

levels 1 and 2, respectively. The optimal allocation of funds is determined by first choosing the most cost-effective resource level for each task, then ranking all tasks according to cost-effectiveness, and, finally, funding tasks in order of decreasing cost-effectiveness until the budget is expended. This process is continued for five years with the state-of-the-art of each task at the beginning of each year depending upon the funding level for the preceding year. This process is shown in Figure 1.

The following reports are generated by the program:

- Input data listing
- Input error listing
- System support versus task matrix
- Adjusted system support versus task matrix
- Technological objective versus task matrix
- Limited war support versus task matrix
- 1498 associated work units, listed by task
- Cost-effectiveness ranking (Priority List) for each year
- Project summary for each year (Annual Report)
- Five year project summary (Final Report)
- List of tasks not selected for five years
- Technological objective and system support profiles
- Facility utilization report

Examples of the reports are presented in Section III.

The first seven reports are written prior to the optimization phase and therefore are not dependent upon the results of the task funding procedure. The limited war data and the 1498 associated work units are not used in calculations within the program. The facilities used by a given task are neglected in determining its cost-effectiveness. The facility utilization report is used as an aid in predicting the facility requirements generated by the optimal selection of the tasks.

The term "optimal selection" usually signifies a linear programming approach to solving the budget allocation problem. This problem can indeed be structured as a linear programming problem with the simplication, however,

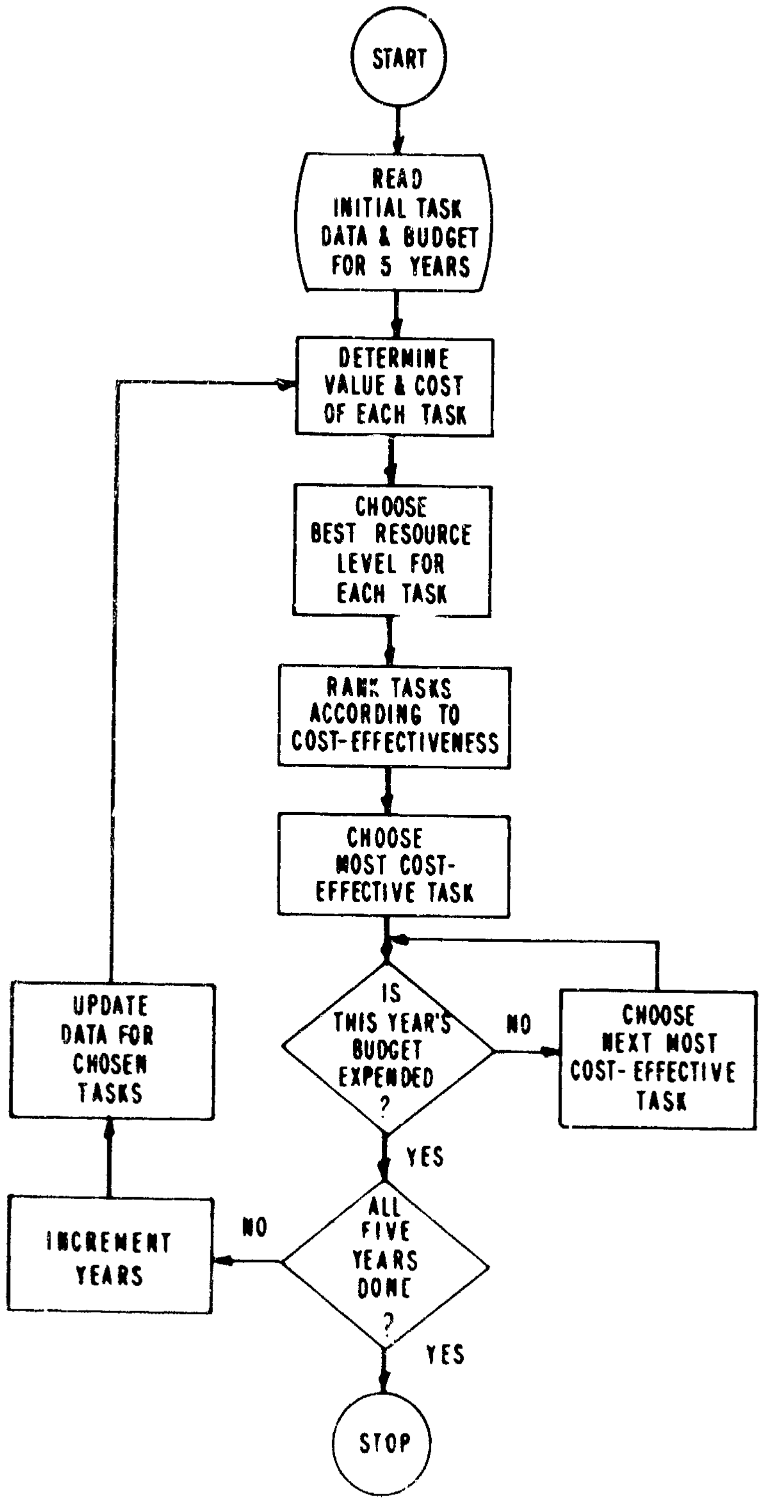
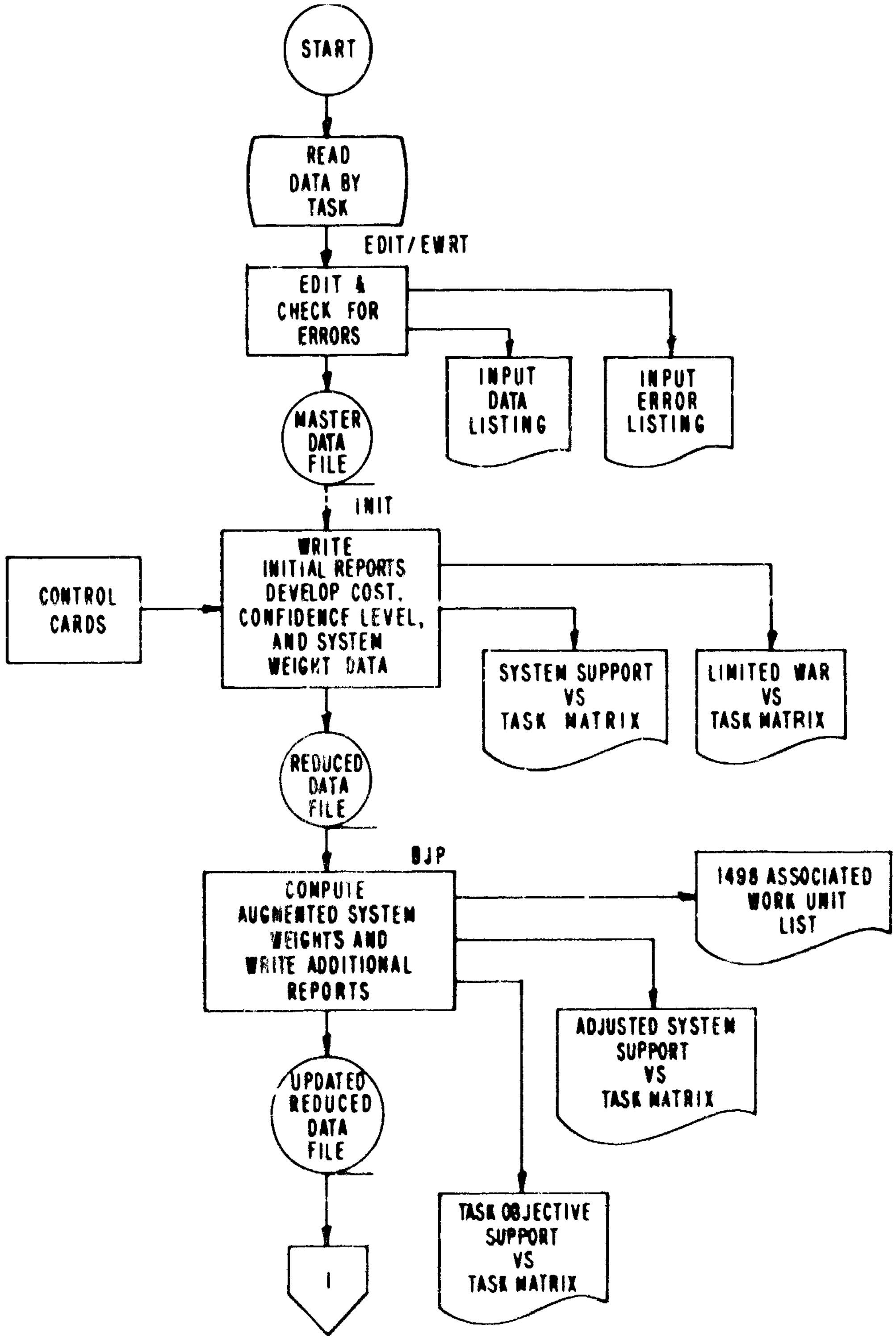


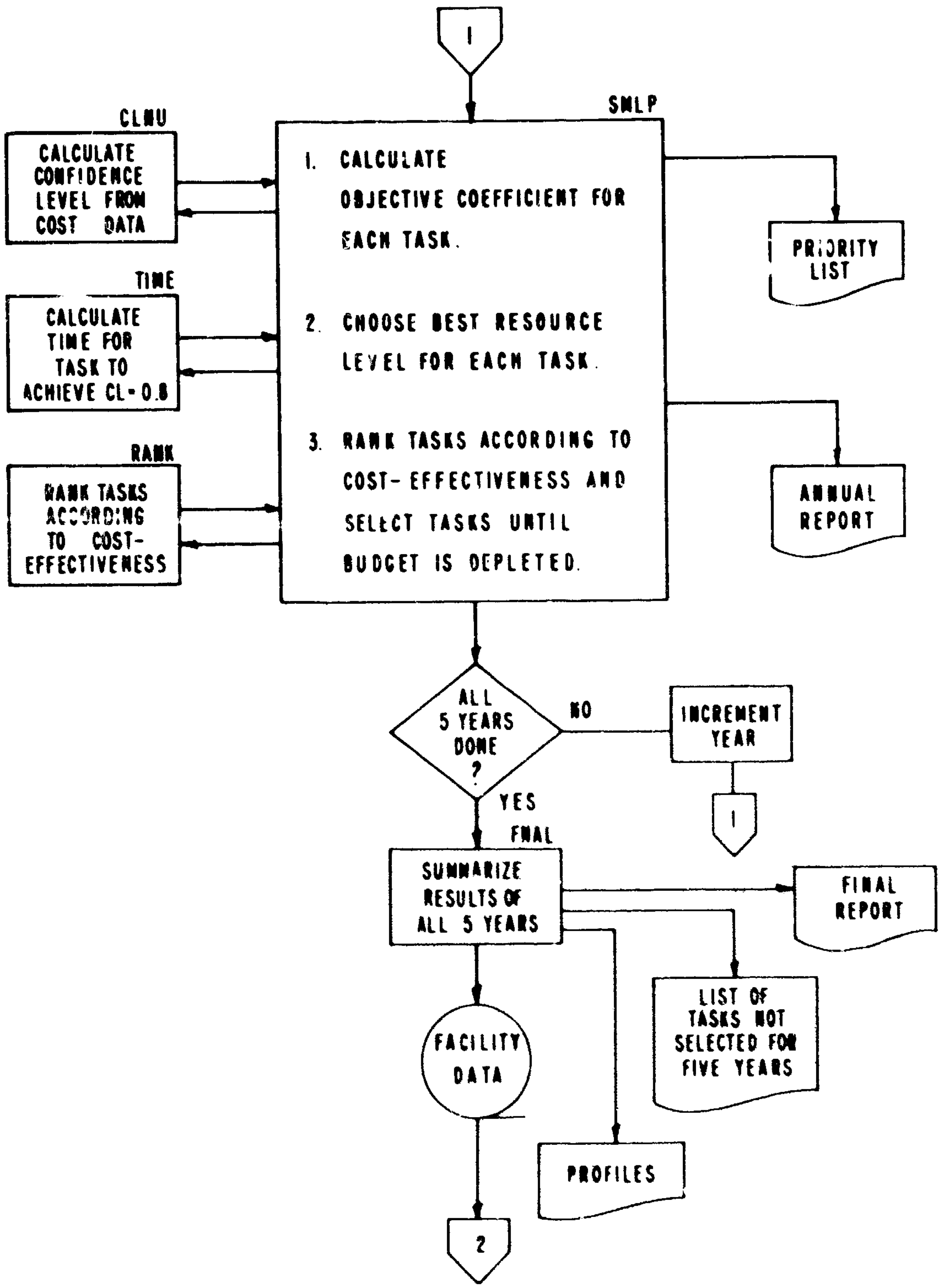
Figure 1. RDE Logic Flow Diagram

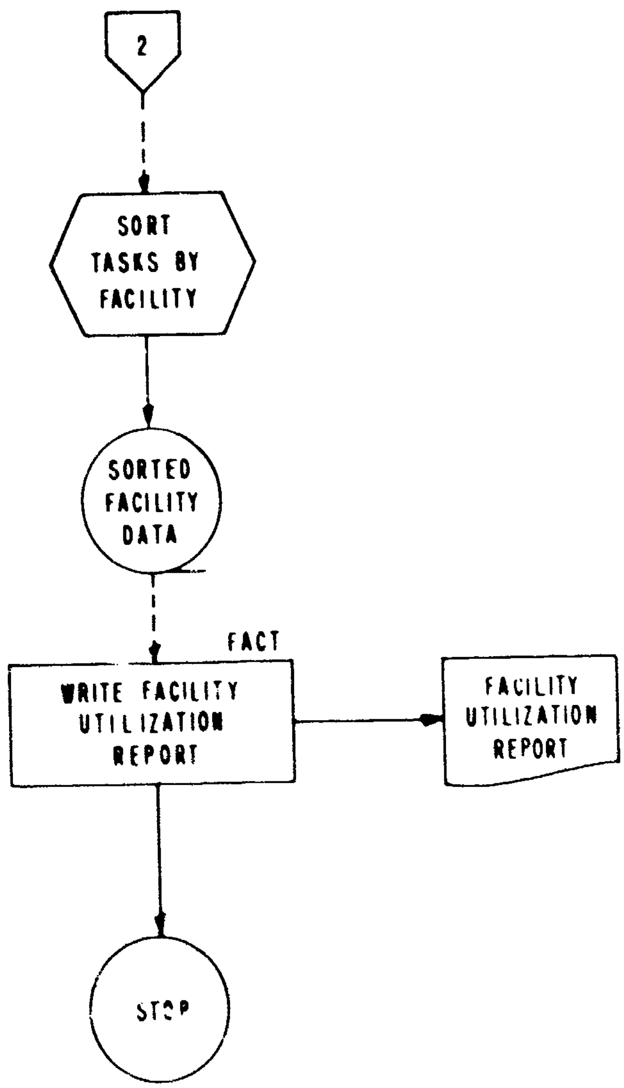
of having only one constraint, money. The existence of only one constraint eliminates the need for the commonly used Simplex algorithm and allows selections to be made on the criteria of highest ratio of objective coefficient (value) to row coefficient (cost).

Earlier versions of this program did employ the Simplex algorithm to solve the problem because exploratory development laboratory manpower was considered a constraint. This constraint, however, has been eliminated because of the realistic assumption that, if a manpower limit has been met before the laboratory's budget has been expended, the surplus funds can be used to employ more personnel.

3. SYSTEM FLOW DIAGRAM




1
CLMU
CALCULATE CONFIDENCE LEVEL FROM COST DATA
TIME
CALCULATE TIME FOR TASK TO ACHIEVE CL-0.8
RANK
RANK TASKS ACCORDING TO COST-EFFECTIVENESS
SMLP
1. CALCULATE OBJECTIVE COEFFICIENT FOR EACH TASK.
2. CHOOSE BEST RESOURCE LEVEL FOR EACH TASK.
3. RANK TASKS ACCORDING TO COST-EFFECTIVENESS AND SELECT TASKS UNTIL BUDGET IS DEPLETED.
PRIORITY LIST
ANNUAL REPORT
ALL 5 YEARS DONE ?
NO
INCREMENT YEAR
1
YES
FINAL
SUMMARIZE RESULTS OF ALL 5 YEARS
FINAL REPORT
LIST OF TASKS NOT SELECTED FOR FIVE YEARS
FACILITY DATA
PROFILES
2


2
SORT TASKS BY FACILITY
SORTED FACILITY DATA
FACT
WRITE FACILITY UTILIZATION REPORT
FACILITY UTILIZATION REPORT
STOP

4. DESCRIPTION OF ROUTINES

a. EDIT Routine

This routine reads in the following data for each task:

- Division number
- Project number
- Task number
- Subtask number
- Task engineer's name, office symbol, and telephone extension
- Project engineer's name
- Limited war support data including degree of support to limited war, special air warfare, interdiction, close air support, and logistics.
- Ranking of task within the division
- Task title
- Confidence levels achieved during preceding four years
- Contract and support funds used during preceding four years
- Contract and support funds requested for present year for both resource levels
- Contract engineers and in-house engineers requested for present year for both resource levels
- Identification number of each technological objective supported by this task and the percent of the total task effort that directly affects the completion of that technological objective
- Identification number of each system supported by this task and the percent of the total task effort that directly affects the progress of that system
- 1498 associated work units
- Amount of contract and support funds and engineering manpower necessary to achieve each confidence level
- Identification number of each facility used to achieve each confidence level and the required number of occupancy hours

Most of this data is not operated upon in EDIT since the primary purpose of this routine is to eliminate data input errors. In addition to making several sequence checks to assure that all the data for each task is in its proper order, the following error checks are made:

- Division number too large
- Division ranking exceeds number of tasks within the division (This requires that the number of tasks per division be available as part of the program)
- Confidence level less than .2 or greater than .8
- Illegal system identification number
- System support greater than 100%
- Illegal technological objective identification number
- Technological objective support greater than 100%
- Total engineers less than .3 for resource level one
- Total engineers for resource level two greater than double the total engineers for resource level one
- Total engineers for resource level two less than total engineers for resource level one
- Illegal facility code (This requires that a list of all facility codes be available as part of the program)
- Zero occupancy hours needed for a given facility
- Non-zero occupancy hours associated with no facility
- Confidence level data not given in steps of .1

Manipulation of the data only occurs when the confidence level of a task for 1968 is not an even tenth. The confidence level calculating routine CLNU requires the cost to go from one even tenth to the next largest even tenth. Therefore, in the case of a task not starting at an even tenth, the given data must be extrapolated in the following manner.

Let CLH(4) be the non-even tenth confidence level for 1968 and CAS be the contract plus support funds needed to achieve the next largest even-tenth confidence level CLA. Letting $\left[x \right]$ represent the largest integer $\leq x$, CLA is

equal to $.1 \left[10. \cdot CLH(4) \right] + .1$, and therefore the cost to go from CLA - .1 to CLA is $\frac{.1 \cdot CAS}{CLA - CLH(4)}$. The engineer data to go from CLH(4) to CLA must also be multiplied by $\frac{.1}{CLA - CLH(4)}$ to determine the number of engineers needed to go from CLA - .1 to CLA.

b. EXEC Routine

The function of the executive routine is to:

1. Read in the budget constraints, number of years, and the logical variables which control report generation and resources level ceilings.

2. Perform necessary tape positioning functions.

3. Control iteration on multi-year passes.

c. INIT Routine

This routine reads in the edited input and writes out the limited war versus task matrix and the system support versus task matrix including the row averages. These averages are the sum of the system contributions for a given task divided by the number of systems supported by that task. The column totals and averages are also printed. The column total for a given system is the sum of the contributions for all tasks that support that system. The column average for a given system is the sum of the contributions divided by the number of tasks that support that system. These column averages are retained and become input to the BJP routine.

Since the only constraint to the optimization problem is money, all costs associated with a given task are adjusted to include the costs of the contract and in-house engineers. The equation used for this process is:

$$C_k = CS_k + CENG \cdot (EC_k + EI_k) \qquad (1)$$

where

k is the resource level

CS_k is contract and support dollars

EC_k is contract engineers

EI_k is in-house engineers

and

CENG is the cost of employing one engineer for one year. This cost is currently set at $12.7 (Note that all costs are expressed in thousands of dollars).

d. BJP Routine

The input for this routine is the edited task data and the average contribution for each system. The output is the 1498 associated work unit list, the adjusted system support versus task matrix, and the technological objective support versus task matrix including row averages.

The adjusted system contributions are determined by the following equation:

$$\text{if} \quad b_j \leq \bar{b}_j \,, \quad b'_j = b_j \tag{2a}$$

$$\text{if} \quad b > \bar{b}_j \,, \quad b'_j = b_j \left[1 + 2.5 (b_j - \bar{b}_j) \right] \tag{2b}$$

where

b_j is the original system contribution

b'_j is the adjusted system contribution

and

$\bar{b}_j$ is the average system contribution for all tasks.

This adjustment has the effect of increasing the contributions to a system for those tasks whose support is greater than the average. In most cases the average contribution for a task is higher than its unadjusted average on the system support matrix; it cannot be lower.

e. SMLP Routine

SMLP, the "simulated linear programming" routine, is the central subprogram of the system. A thorough understanding of this routine is necessary

for the successful implementation of the RDE program. The major requirement of this program (solving for the optimal allocation of funds) can be described as a linear programming problem with the variables being the resource levels of the different tasks. The constraint equation of this problem is the inequality requiring that the sum of the costs of the selected tasks does not exceed the laboratory's budget; the objective function is the linear functional representing the sum of the values of the resource levels of each selected task. Since there is only one constraint equation, and since the variables can only be 1 or 0, representing funded or not funded, the iterative Simplex method of solving linear programming problems can be replaced by the more direct approach of considering the ratio of value to cost for each resource level of each task.

RDE_k, the value of resource level k for a given task, is determined by the following equation:

$$RDE_k = \frac{CL'_k - CL}{CL} \left(d \cdot B_k + T_k \right) \qquad (3)$$

where CL is the present confidence level of the task

CL'_k is the confidence level achieved if the task is funded at RL_k

d is the ranking factor

B_k is the total system contribution

and T_k is the total technological objection contribution

The confidence level, CL, for the first year of a five-year problem is given as input data. The confidence level for each succeeding year remains at CL if the task is not selected, or becomes the CL'_k of the preceding year if resource level k is selected. The projected confidence level, CL'_k, is determined by linear interpolation of the cost versus confidence level function derived from the input data.

Let x_m represent a confidence level of $.1 \cdot m$ where $m = 2, \ldots, 8$ and let z_m represent the cumulative cost to reach x_m starting at CL. Then if C_k, the

resource level k funds, is contained in the interval, $z_m < C_k \leq z_{m+1}$, the projected confidence level, CL'_k, can be determined by the following equation:

$$CL'_k = x_m + 0.1 \frac{C_k - z_m}{z_{m+1} - z_m} \tag{4a}$$

If, however, $C_k \leq z_m$ where $x_{m-1} \leq CL < x_m$, the following equation must be used:

$$CL'_k = CL + (Xm - CL) \frac{C_k}{z_m} \tag{4b}$$

The following input data will be used to determine a cost versus confidence level graph (Figure 2) and as sample data to clarify some of the equations.

$CL = .24$ $\quad C_1 = 13$ $\quad C_2 = 25$

CONFIDENCE LEVEL	COSTS TO ACHIEVE
.3	10
.4	0
.5	20
.6	20
.7	0
.8	5

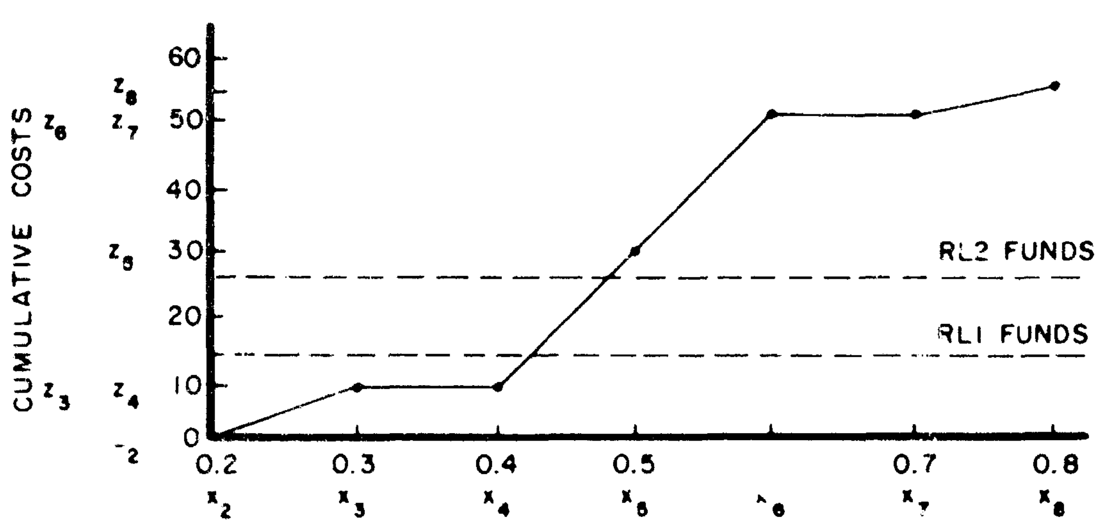


Figure 2. Cost versus Confidence Level Graph

Using the above sample data, CL'_1 for the first year can be calculated from (4a) as follows:

$$CL'_1 = x_4 + 0.1 \times \frac{C_1 - z_4}{z_5 - z_4} = 0.4 + 0.1 \times \frac{13-10}{30-10}$$

$$= 0.4 + 0.1 \times \frac{3}{20} = 0.415 = 0.41^*$$

and if resource level 1 were selected for the first year, CL'_2 for the second year is:

$$CL'_2 = x_5 + 0.1 \times \frac{C_2 - z_5}{z_6 - z_5} = 0.5 + 0.1 \times \frac{25-18}{38-18}$$

$$= 0.535 = 0.53^*$$

Note that $z_5 = \frac{.5 - .41}{.1} \times 20 = 18$ and $z_6 = z_5 + 20 = 38$

The ranking factor d is used to adjust the total system contribution of a task according to its relative importance with respect to the other tasks of that division. The equation for determining d is:

$$d = e^{-x^2} + 0.37 \qquad (5)$$

where $x = \frac{R-1}{D_n - 1}$

$e = 2.71828\ldots$

R is the ranking of the task within the division

and D_n is the number of tasks in division n.

Note that d ranges from 1.37 for R = 1 (the most important task) to $\frac{1}{e} + .37 = .367 + .37 = .737$ for $R = D_n$ (the least important task).

The total system contribution, B_k, is calculated by the following equation:

$$B_k = \sum_j b'_j \cdot c_j \cdot T_{k,j} \qquad (6)$$

where b'_j is the adjusted contribution of this task to system j

c_j is the weight of system j as determined by AFFDL

* CL'_k is always truncated to the nearest hundredth because any smaller increment has no useful meaning.

and $\mathcal{T}_{k,j}$ is the timeliness factor for resource level k with respect to system j.

$\mathcal{T}_{k,j}$ is dependent upon the ratio of y_k to t_j where y_k is the number of years of resource level k funding required to reach a confidence level of .8 and t_j is the required progress rate from system j. Actually, t_j is the expected time-to-completion for system j as determined by Hq AFSC. The ratio $\frac{y_k}{t_j}$ then defines $\mathcal{T}_{k,j}$ as follows:

$$
\begin{aligned}
&\text{If} \quad \frac{y_k}{t_j} \le 0.5, && \mathcal{T}_{k,j} = 2 \cdot \frac{y_k}{t_j} \\
&\text{If} \quad 1.5 < \frac{y_k}{t_j} \le 1.5, && \mathcal{T}_{k,j} = 1 \\
&\text{If} \quad 1.5 < \frac{y_k}{t_j} \le 2.0, && \mathcal{T}_{k,j} = 4 - 2 \cdot \frac{y_k}{t_j} \\
&\text{If} \quad 2.0 < \frac{y_k}{t_j}, && \mathcal{T}_{k,j} = 0
\end{aligned}
\tag{7}
$$

This is shown graphically by Figure 3.

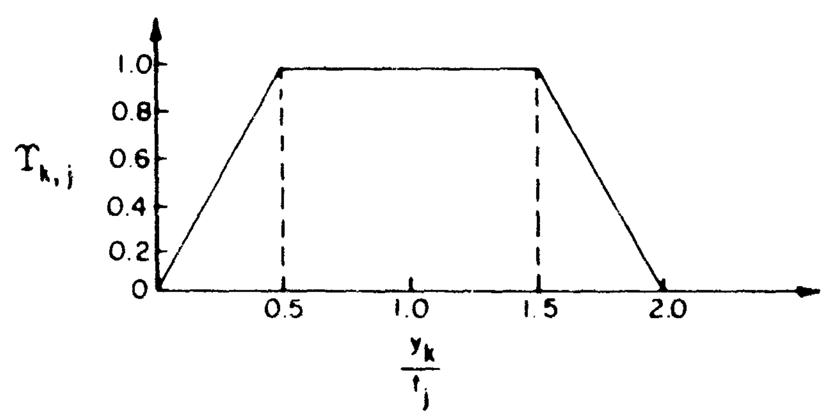


Figure 3. Timeliness Function Graph

The purpose of this function is to devalue those tasks which will be completed too early or to late to aid the development of the system. y_k is determined by first calculating the confidence level achieved when the task is funded at resource level k for the first year. If $CL'_k < 0.8$, CL becomes CL'_k and a new CL'_k is calculated by again funding the task at resource level k. This procedure continues until CL'_k exceeds 0.8. The number of years that are required to reach .8 in this manner is y_k. (Fractional years are considered whole years).

For example, using the data of Figure 2, y_1 and y_2 can be determined as follows:

YEAR	CL_1	CL_2
1969	.2	.2
1970	.41	.47
1971	.47	.59
1972	.53	.8+
1973	.59	
1974	.8+	

Therefore, $y_1 = 5$ and $y_2 = 3$.

Then, for $t_6 = 3$,
$\Upsilon_{1,6} = 4 - 2 \cdot \frac{5}{3} = \frac{2}{3}$ and
$\Upsilon_{2,6} = 1$.

The total technological objective contribution is calculated by the following equation:

$$T_k = \sum_j g_j \cdot h_j \cdot \Upsilon_{k,j} \qquad (8)$$

where g_j is the contribution of this task to technological objective j

h_j is the weight of technological objective j as determined by AFFDL

and $\Upsilon_{k,j}$ is the timeliness factor for resource level k with respect to technological objective j. $\Upsilon_{k,j}$ is calculated in the same manner as the timeliness factor for systems. This requires that the progress rate for each technological objective be given.

After the two objective coefficients, RDE_1 and RDE_2, have been calculated, the maximum ratio of $\frac{RDE_k}{C_k}$ is determined.* The resource level k giving this maximum is then the most cost-effective resource level for this task. After the most cost-effective resource level is determined for every task, the cost-effectiveness ratios are arranged in descending order. The tasks are then funded in this order until the entire laboratory budget is expended. If, after r tasks are funded, the cost of the (r + 1) st task is greater than the remaining budget, the (r + 1) st task is not funded.** The confidence levels of the funded tasks are updated to the CL'_k associated with the selected resource level. After the selections

*If $CL'_k > .8$, C_k becomes $10 \cdot (.8 - CL) \cdot C_k$.

**It is possible to continue to search the list for a task whose required funds are less than the remaining budget. This is not done by this routine and therefore the above set of selections is not truly optimal unless, of course, no task can be found in the remaining list whose required funds are less than the remaining budget.

are made and confidence levels updated, this routine writes out the Priority List and the project summary (Annual Report) for the year being considered.

f. FNAL Routine

This routine is used if more than one year is being optimized. It is entered after the budgets for all years have been optimally allocated. The results of these optimizations and the edited input is used to construct a history of each task for the time period under consideration. A maximum time period of five years is allowed. Any task not selected during this time period is added to the list of "tasks not selected for any year." This routine also writes the system and technological objective profiles. These profiles show the progress of those tasks that support each system or technological objective at a level ≥ .7.

As the final report for each task is being written, the facility-utilization input data is interrogated to determine the number of facility occupancy hours used by each task during each year. A task is charged for using a facility during the year it reaches the confidence level associated with that facility. If the confidence level of a task is increased by more than .1 during a year, the number of facility occupancy hours used is the sum of the hours associated with the confidence level gained. This is illustrated by the following sample case. If the input data for a task includes:

CL	FACILITY CODE	OCCUPANCY HOURS	FACILITY CODE	OCCUPANCY HOURS
.3	1000	15	2000	24
.4	3000	30	3005	12
.5	3000	15		
.6	2000	40	3005	24
.7	1000	120	2000	50
.8	2000	20	3000	12

and if the task history is:

1968	1969	1970	1971	1972	1973
.28	.40	.46	.52	.73	.76

then the facility utilization is:

FACILITY CODE	1969	1970	1971	1972	1973
1000	15	0	0	120	0
2000	24	0	0	90	0
3000	30	0	15	0	0
3005	12	0	0	24	0

g. FACT Routine

The main function of this routine is to match the facility codes with the facility titles and to determine the total yearly usage of each facility. The input to this routine is the sorted facility data from FNAL and the list of all facility titles. The output is the facility utilization report.

3. APPLICATIONS AND LIMITATIONS

This program, as written, is constrained to the structure of AFFDL; hence emphasis has been on a consistent and well-defined program structure. Obviously, most organizations will not have five divisions and their hierarchal arrangement will be more or less than the three levels (division, project, task) assumed by this program. This type of organizational difference, however, is not too critical since the determination of the value coefficient (except for the AR factor) and the allocation of funds are not affected by the organizational structure. It is, therefore, possible for an organization with more or less than five divisions to redefine these divisions to give exactly five distinct groups. This may not always be desirable, but when it is, it eliminates the time and effort needed to modify the program. Likewise, if the organization has more than three hierarchal levels, it may be possible to define a task in a manner that includes more than one lower level. AFFDL accomplishes this by defining more than one subtask for the same task.

The system and technological objective contribution terms of the value coefficient may seem to be Air Force dependent. There is no reason, however, to preclude these being used to represent items such as company goals or products

manufactured. As an example, for an activity representing the development of a very efficient distillation process for a chemical company, the g_j terms could represent the contribution of this process to the manufacturing of each of the company's products and the h_j terms could represent the importance of each of these products to the overall company development.

A possible future revision is the increase of the number of resource levels. Programming-wise, it is a minor change and could be implemented within a few days. The added resource levels would result from interpolating the linear function derived from the two points RL1 and RL2, i.e., RL1.1 resources would be RL1 resources plus .1 of the resources between RL1 and RL2. The advantage of having additional resource levels would be an increase in the completed overall effectiveness of the lab and a more flexible funding approach for each task. The disadvantage, however, of this approach lies in the assumption that the function formed by the two resource levels is linear and not step-wise continuous as is probably the case. Related to this disadvantage is the task engineer's confusion and lack of confidence in the program caused by his being asked to perform his activity at a budgetary and manpower level that he had not presented to the program. Our experience has shown that better task engineer cooperation has been achieved by keeping the number of funding levels at a minimum and, therefore the alternative of additional resource levels has not, as yet, been implemented.

The "facility-utilization" data in no way affects the optimal allocation of resources. This may not be a realistic assumption, and, particularly if a facility is being used beyond its capacity, it may be desirable to constrain its use. One method of doing this would be the non-funding of tasks using this facility once its capacity is met, assuming, that funding is done by ranking on the priority list. This would eliminate over-usage but would result in a suboptimal allocation since the linear-programming problem would now have two constraints, thereby requiring an iterative L. P. solver. If the disadvantage of using a large L. P. algorithm is more attractive than the disadvantage of exceeding facility capacities, it is then suggested that all facility constraints be considered in the L. P. program and activities representing the construction of new facilities be added.

The program as written will only optimize for up to five years. This limit of five years may be increased indefinitely since the iterative process is independent

of the number of years to be optimized. The only modifications required in the program would be to change the storage allocation of some of the variables and to revise the FINAL REPORT, FACILITY REPORT, and the PROFILES. Before the decision to increase the number of years is made, however, it must be noted that any allocation beyond the first year is suboptimal since it does not consider those tasks that may originate during the following year. Particularly, during the later years, it is possible to have an excess of funds since many tasks may have already reached .8 in preceding years. One solution to this problem is to have the budget decrease by a given percent each year. This is equivalent to assuming that each year the newly proposed tasks will require a given percentage of the budget. It should also be noted that the overall effectiveness of the laboratory for <u>five years</u> is larger when all five years are considered simultaneously than when each year is considered separately, even though the effectiveness of individual years may be lower. The problem of considering all five years simultaneously is quite complicated, however, and would again require a large-scale L.P. solver.

If it is desirable to negate the influence of the AR factor in the objective coefficient, the easiest approach would be to use the same AR number for every task. If, however, modifications have to be made to the program, the easiest solution would be to eliminate the AR factor from the value coefficient equation. The value coefficient also contains the term $\frac{1}{CL}$. This dividing of the value coefficient by the present confidence level has the effect of heavily weighting those tasks with low confidence levels. This is done to emphasize starting tasks over tasks nearing completion and is consistent with the philosophy of the Air Force Flight Dynamics Laboratory. If, however, this emphasis is not desirable, the $\frac{1}{CL}$ term should be deleted from the value coefficient equation.

The assumption of constant resource level funds and manpower for all five years leads to somewhat biased results in favor of those tasks which have rather constant resource requirements to reach each confidence level. In particular, those tasks which require very little funds to reach all but one confidence level and large funds to achieve the remaining confidence level may never get selected. This is caused by their RL1 and RL2 funds not being adequate for them to reach .8 in time to get credit for the systems and technological objectives supported.

The director of this type of task may also be embarrassed by being selected at a resource level for one year which (from his cost versus confidence level function) indicates that he should be able to increase his confidence level by up to .4 when, in fact, other nonmonetary constraints exist that limit his progress to an increase of at most .1. A possible future revision to the program that may solve this problem is for the engineer to replace his RL2 data by the maximum confidence level he can achieve each year. RL2 could then be the resources needed to reach this given confidence level.

When this program is used for the first time, there may be a tendency for the task engineer, or his equivalent if a different organization structure exists, to "beat the system" to assure funding. This can easily be done by overestimating the progress attainable from his requested resources. This manipulation of the data can be discouraged by careful examination by the engineer's supervisor and by reference to the historical data. An interesting addition to the program could be the identification of those tasks whose predicted progress is inconsistent with their historical data.

SECTION III

INPUT-OUTPUT DESCRIPTION

1. INPUT FORMAT

The input form is shown in Figure 4. There is a maximum of 12 cards per task. Columns 1 - 8 of every card contains the variable ITASK; column 78 of every card is blank; and columns 79 - 80 of every card contains the card sequence number.

Each card will be described separately with the descriptors in the MODE column defined as 'I' for integer, 'R' for real number, and 'A' for alphanumeric data. All real numbers must either contain a decimal point or be right-justified if a decimal point is not used. All monetary input is in thousands of dollars. Card 1 contains:

COLUMN	VARIABLE	MODE	DESCRIPTION
1 - 8	ITASK	I	Task number, must be integer $\geq 100,000$
9 - 29	NAMT (1,...,4)	A	Task engineer's name, preferably with last name first.
30	IDIV	I	Division number, must be ≤ 5, checked by EDIT
31 - 35	ISYM	A	Office symbol
36 - 40	LEXT	A	Telephone extension
41 - 64	NAMP (1,...,4)	A	Project engineer's name, again with last name first
65 - 66	LIM(1)	A	Percent of task's effort supporting limited war
67 - 68	LIM(2)	A	Percent of task's effort supporting special air warfare
69 - 70	LIM(3)	A	Indicator denoting a significant contribution to the Air Force's performance of its classical role of interdiction. 'XX' indicates contribution; blank indicates no contribution

COLUMN	VARIABLE	MODE	DESCRIPTION
71 - 72	LIM(4)	A	'XX' or blank, denoting contribution to close air support
73 - 74	LIM(5)	A	'XX' or blank, denoting contribution to logistics
75			Blank
76 - 77	AR	R	Rank of task within division. "1" represents the most important task. EDIT checks the rank to assure that it does not exceed the number of tasks within its division.
78			Blank
79 - 80	IC	I	'01' representing the first card for this task. Checked by EDIT.

Card 2 contains:

COLUMN	VARIABLE	MODE	DESCRIPTION
9 - 54	ITITLE (1,...,8)	A	Task title containing up to 46 characters
55 - 59			Blank
66 - 63	CS(1)	R	Contract plus support funds requested at RL1 for 1969
64 - 67	CS(2)	R	Contract plus support funds requested at RL2 for 1969
68 - 69			Blank
70 - 72	CLH(1)	R	Confidence level of this task at end of FY 1965 (must be $<$ .8)
73			Blank
74 - 77	CSH(1)	R	Contract plus support funds used in 1965
78			Blank
79 - 80	IC	I	'02'

COLUMN	VARIABLE	MODE	DESCRIPTION
Card 3 contains:			
9			Blank
10 - 54	IT (1,...,15)	I	Identification numbers of technological objectives supported by this task. Use three columns for each T.O. Use leading zeroes. Example: 7 should be written as 007
55 - 59			Blank
60 - 63	EC(1)	R	Contract engineers requested at RL1 for FY 1969
64 - 67	EC(2)	R	Contract engineers requested at RL2 for FY 1969
68 - 69			Blank
70 - 72	CLH(2)	R	Confidence level of this task at end of FY 1969
73			Blank
74 - 77	CSH(2)	R	Contract plus support funds used in FY 1966
78			Blank
79 - 80	IC	I	'03'
Card 4 contains:			
9			Blank
10 - 54	T (1,...,15)	R	Percent of task's effort that supports the T.O.'s directly above these columns. Use three columns for each T.O. supported. Entry must contain decimal point and be $\leq$ 1.
55 - 59			Blank
60 - 63	EI(1)	R	In-house engineers requested at RL1 for FY 1969

COLUMN	VARIABLE	MODE	DESCRIPTION
64 - 67	EI(2)	R	In-house engineers requested at RL2 for FY 1969
68 - 69			Blank
70 - 72	CLH(3)	R	Confidence level of this task at end of FY 1967
73			Blank
74 - 77	CSH(3)	R	Contract plus support funds used in FY 1967
78			Blank
79 - 80	IC	I	'04'
Card 5 contains:			
9			Blank
10 - 39	IS (1, . . . , 15)	I	Identification numbers of all systems supported by this task. Use two columns for each system. Use leading zeroes.
40 - 69			Blank
70 - 72	CLH(4)	R	Confidence level of this task at end of FY 1968
73			Blank
74 - 77	CSH(4)	R	Contract plus support funds used in FY 1968
78			Blank
79 - 80	IC	I	'05'
Card 6 contains:			
9			Blank
10 - 39	S (1, . . . , 15)	R	Percent of task's effort that supports the systems directly above these columns. Use two columns for each system supported. Entry must contain decimal point and be less than 1.

COLUMN	VARIABLE	MODE	DESCRIPTION
40 - 69	RWU (1,...,10)	I	1498 related work units. Use three columns per unit. Use leading zeroes
70 - 78			Blank
79 - 80	IC	I	'06'

Card 7 contains:

COLUMN	VARIABLE	MODE	DESCRIPTION
9			Blank
10 - 11	CL	R	Base confidence level of the confidence level versus cost curve. It is the first even tenth greater than CLH (4). Column 10 must contain a decimal point. $.3 \leq CL \leq .8$
12 - 16	CAS	R	Contract plus support funds necessary to reach CL from CLH (4)
17 - 21	ENC	R	Contract engineers needed to reach CL from CLH (4)
22 - 26	ENI	R	In-house engineers needed to reach CL from CLH (4)
27 - 30	IFAC (1)	I	Identification number of one of the facilities needed to reach CL from CLH (4)
31 - 34	OCC (1)	R	Number of hours of use of facility IFAC (1) needed to reach CL from CLH (4). Fractional hours not considered.
35 - 42	IFAC(2), OCC(2)	I, R	Same as 27 - 34
43 - 50	IFAC(3), OCC(3)	I, R	Same as 27 - 34
51 - 58	IFAC(4), OCC(4)	I, R	Same as 27 - 34
59 - 66	IFAC(5), OCC(5)	I, R	Same as 27 - 34
67 - 74	IFAC(6), OCC(6)	I, R	Same as 27 - 34
75 - 78			Blank
79 - 80	IC	I	'07'

Cards 8 - 12 have the same format as card 7 with the exception that CL now is the previous CL + .1 and all the resources (CAS, ENC, ENI) and facilities represent the requirements of going from the previous CL to the present CL. If CL is .8, no more cards should follow for this task.

The set of up to twelve cards per task is read into the EDIT routine. This data must be preceded by a card containing, in columns 1 through 5, the total number of tasks. This number is used as a check to guarantee that the data for all tasks has been read in. A maximum of 250 tasks may be considered. The output from EDIT is the master file which is input to the INIT routine. The following two control cards are required as input to the EXEC routine (refer to System Flow Diagram, Section 1.3). Card 1 contains:

COLUMN	VARIABLE	MODE	DESCRIPTION
1 - 5	DOFAC	L*	'T' if facility report is to be written. 'F' otherwise.
6 10	DOREP	L	'T' if the system support matrix, the adjusted system support matrix, the technological objective matrix, the limited war matrix, and 1498 associated work unit list are to be written.
11 - 15	DOPRO	L	'T' if technological objective and system profiles are to be written
16 - 20	DORLI	L	'T' if resource level 1 can only be used
21 - 25	DORL2	L	'T' if resource level 2 can only be used

Card 2 contains:

1 - 5	LASTY	I	Number of years to run program. Must be ≤ 5
6 - 15	BUDG(1)	R	First year budget
16 - 25	BUDG(2)	R	Second year budget
26 - 35	BUDG(3)	R	Third year budget
36 - 45	BUDG(4)	R	Fourth year budget
46 - 55	BUDG(5)	R	Fifth year budget

* L denotes logical variable

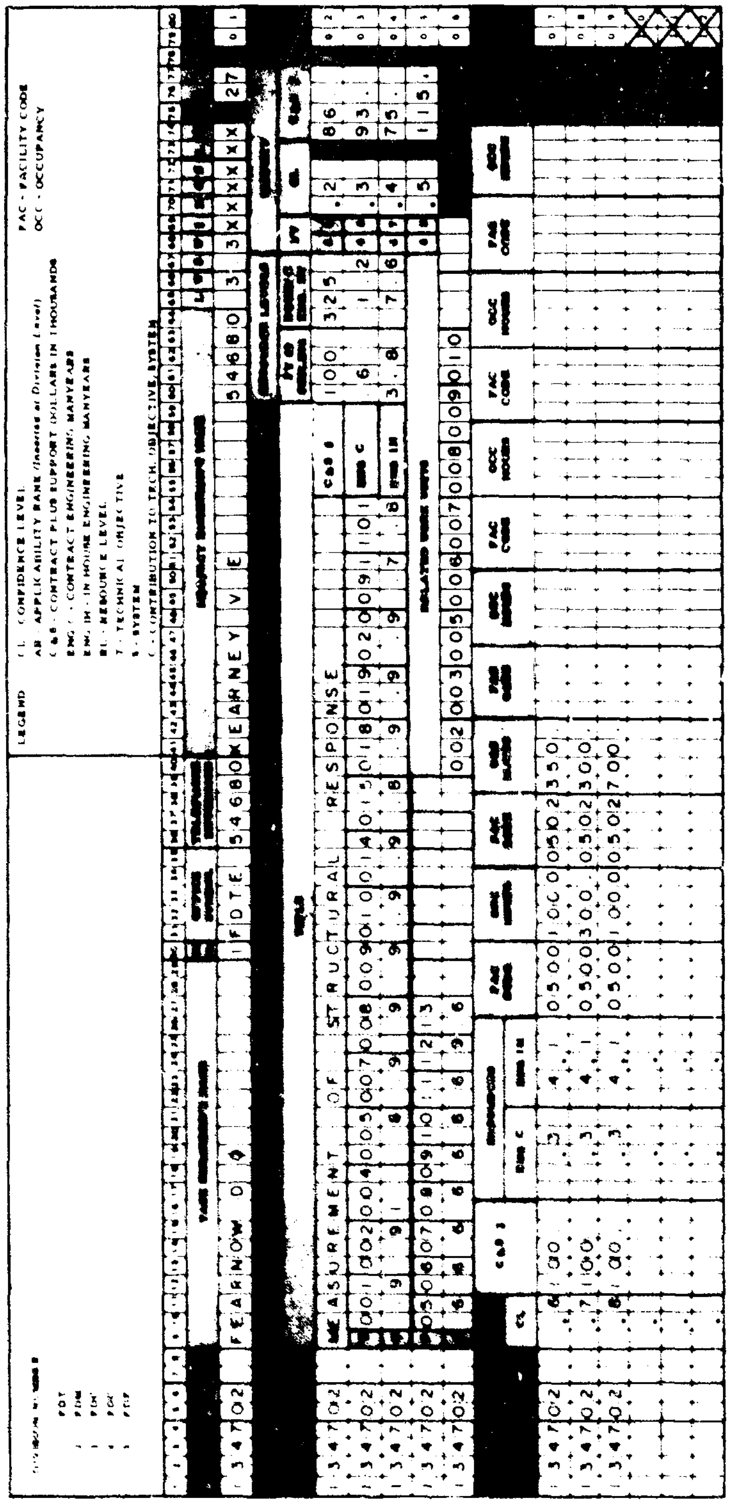


Figure 4. Sample Input Form

2. PROGRAM CONSTANTS

The following information, although in data statements within the program, is peculiar to the Air Force Flight Dynamics Laboratory and, therefore, should be considered as input data. The defining routines for this data are in parentheses.

- List of valid facility codes (EDIT)
- Number of tasks within each division (EDIT, INIT)
- Specified times-to-completion for systems and technological objectives (BLOCK DATA)
- Designated weights of systems and technological objectives (BJP)
- Cost of one engineer for one year (BLOCK DATA)
- Project titles (BLOCK DATA)
- Division titles (SMLP)
- Facility grouping titles (FACT)

In addition to the above information, the titles for each facility are read in by the FACT routine under an (I4, 9A6, A2) format. Columns 1 - 4 of each card contain the facility code and columns 5 - 60 contain the facility title.

```
                                        RDE  FY  1969  INPUT  DATA                                              15 APR 68

DIVISION  1       TASK  13470200    TITLE    MEASUREMENT  OF STRUCTURAL RESPONSE                 AR 27        LIMITED  WAR  DATA
                                                                                                              LW  SW  IN  CS  LG
                                                                                                              .3  .3  XX  XX  XX
                      SUPPORT  OF  TECH  OBJS                                           SUPPORT  OF  SYSTEMS
TO    001 002 004 005 007 008 009 010 014 015 018 019 020 091 101      SYS  05 06 07 08 09 10 11 12 13
SUP    .9  .9  .0  .8  .9  .9  .9  .9  .9  .8  .9  .9  .9  .7  .8      SUP  .6 .6 .6 .6 .6 .8 .6 .9 .6 .  .  .  .  .  .  .

                  HISTORY                          FY - 69  RESOURCES
          65      66      67      68                       CS     ENGC    ENGIH         ASSOCIATED  1498  WORK UNITS
CL      0.20    0.30    0.40    0.50            RL1   100.0     0.6      3.8        002  003  005  006  007  008  009  010
CS      86.0    93.0    75.0   115.0            RL2   325.0     1.2      7.6

  CL VS. RESOURCE DATA                                               FACILITY  UTILIZATION
CL       CS    ENGC   ENGIH        FACILITY   OCC    FACILITY   OCC    FACILITY   OCC    FACILITY   OCC    FACILITY   OCC    FACILITY   OCC
                                     CODE    HOURS     CODE    HOURS     CODE    HOURS     CODE    HOURS     CODE    HOURS     CODE    HOURS
.6    100.0     0.3     4.1           500    1000.      502     350.
.7    100.0     0.3     4.1           500     300.      502     300.
.8    100.0     0.3     4.1           500    1000.      502     700.



DIVISION  1       TASK  13470300    TITLE    STRUCTURAL TESTING CRITERIA                         AR 16        LIMITED  WAR  DATA
                                                                                                              LW  SW  IN  CS  LG
                                                                                                              .3  .3  XX  XX  XX
                      SUPPORT  OF  TECH  OBJS                                           SUPPORT  OF  SYSTEMS
TO    001 002 004 010 013 014 015 018 046                              SYS  05 09 10 11 12 13 14
SUP    .0  .9  .9  .8  .3  .8  .8  .8  .4  .  .  .  .  .  .            SUP  .7 .7 .8 .7 .8 .5 .5 .  .  .  .  .  .  .  .

                  HISTORY                          FY - 69  RESOURCES
          65      66      67      68                       CS     ENGC    ENGIH         ASSOCIATED  1498  WORK UNITS
CL      0.45    0.40    0.50    0.60            RL1   100.0     0.3      6.0        005  007  009  001  012  013
CS       4.0   213.0    56.0    76.0            RL2  1000.0     0.6     12.0

  CL VS. RESOURCE DATA                                               FACILITY  UTILIZATION
CL       CS    ENGC   ENGIH        FACILITY   OCC    FACILITY   OCC    FACILITY   OCC    FACILITY   OCC    FACILITY   OCC    FACILITY   OCC
                                     CODE    HOURS     CODE    HOURS     CODE    HOURS     CODE    HOURS     CODE    HOURS     CODE    HOURS
.7     20.0     0.      6.0           500    4000.
.8      0.      0.     -0.
```

Figure 5.   Input Data Listing

RDE 1969 BJ VERSUS TASK MATRIX 15 APR 68

TASK	SYSTEMS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	AVERAGE ACROSS
13470200	.	.	.	.	.6	.6	.6	.6	.6	.8	.6	.9	.6	.	.	.	0.655
13470300	.	.	.	.	.7	.	.	.	.7	.8	.7	.8	.5	.5	.	.	0.671
13470400	.	.	.	.	.6	.6	.6	.6	.6	.6	.6	.9	.6	.6	.	.	0.630
13670200	.7	.	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7	.7	.	.	0.700
13670201	.7	.	.7	.7	.7	.	.	.	.7	.7	.7	.7	.	.7	.	.	0.700
13671100	.5	.	.5	.5	.5	.5	.5	.	.5	.5	.5	.5	.	.5	.	.	0.500
13671400	.5	.	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.	.	0.500
13671500	.7	.	.7	.7	.7	.	.	.	.7	.7	.7	.7	.	.	.	.	0.700
13671600	.3	.	.3	.3	.3	.	.	.	.3	.3	.3	.3	.	.	.	.	0.300
13671700	.5	.	.	.	.5	.	.	.	.5	.5	.5	.3	.	.3	.	.	0.442
13671701	.1	.	.	.	.	.	.	.	.	.5	.	.	.	.	.	.	0.300
13680200	.	.	.	.	.	.	.	.	.5	.	.	.6	.	.6	.	.	0.566
13680301	.5	.	.5	.5	.5	.5	.5	.5	.5	.5	.	.5	.5	.5	.	.	0.500
13680302	.	.	.	.	.	.	.	.	.	.	.	.0	.	.0	.	.	1.000
13680406	.	.	.	.	.	.	.	.	.	.	.	.7	.7	.7	.	.	0.700
13680600	.5	.	.5	.5	.5	.5	.5	.5	.6	.5	.6	.6	.7	.7	.	.	0.553
13680700	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.	.	0.400
13680900	.	.	.	.	.	.	.	.	.	.	.	.5	.	.5	.	.	0.550
13681001	.6	.	.6	.6	.6	.6	.6	.6	.6	.6	.6	.	.	.	.	.	0.600
13681002	.6	.	.6	.6	.6	.6	.6	.6	.6	.6	.6	.	.	.	.	.	0.600
13681200	.	.	.	.	.	.	.	.	.	.	.7	.7	.	.7	.	.	0.700
13681300	.7	.	.7	.	.	.7	.	.7	.	.	.	.7	.	.7	.	.	0.700
13681401	.7	.	.7	.7	.7	.	.	.	.7	.	.	.	.	.	.	.	0.700
13681403	.7	.	.7	.7	.7	.	.	.	.7	.	.	.	.	.	.	.	0.700
13681502	.7	.	.7	.8	.5	.	.	.	.7	.	.5	.	.	.	.	.	0.650
14670100	.4	.	.	.4	.4	.4	.4	.4	.4	.4	.4	.7	.4	.4	.	.	0.425
14670200	.	.	.5	.5	.5	.6	.5	.	.7	.6	.6	.6	.5	.7	.	.	0.572
14670300	.6	.	.6	.6	.6	.7	.7	.7	.6	.6	.6	.7	.7	.6	.	.	0.638
14670400	.7	.	.7	.7	.7	.4	.4	.4	.7	.7	.7	.5	.	.	.	.	0.600
14670500	.7	.	.	.7	.7	.	.7	.	.8	.	.7	.8	.7	.	.	.	0.725
13660200	.	.	.	.7	.7	.	.	.	.7	.5	.7	.5	.	.5	.	.	0.614
13660300	.	.	.	.	.	.	.	.	.4	.	.4	.6	.6	.7	.	.	0.540
13660500	.	.	.	.	.6	.7	.	.	.6	.6	.6	.7	.	.	.	.	0.633
13660600	.	.	.	.	.	.	.	.	.	.	.	.7	.7	.7	.	.	0.700
13660700	.	.	.	.	.	.6	.6	.6	.4	.4	.4	.8	.7	.8	.	.	0.588
13660800	.	.	.	.	.	.5	.5	.5	.	.	.	.8	.5	.8	.	.	0.600
13660900	.	.	.	.	.	.5	.	.5	.	.	.	.7	.5	.7	.	.	0.580
13661000	.	.	.	.	.	.	.	.	.	.	.	.3	.5	.4	.	.	0.400
13661201	.	.	.	.	.	.	.	.	.	.6	.6	.	.	.	.	.	0.600
13661202	.6	.	.	.6	.6	.	.	.	.	.	.	.	.	.	.	.	0.600
13661203	.	.	.	.4	.4	.	.	.	.4	.4	.	.	.	.	.	.	0.400
13661300	.	.	.	.	.	.	.	.	.	.	.	.6	.	.6	.	.	0.600
13661601	.	.	.	.	.	.	.	.	.	.	.	.8	.	.9	.	.	0.850
13661602	.	.	.	.	.	.	.	.	.	.	.	.9	.	.8	.	.	0.850
13661701	.7	.	.5	.5	.5	.	.	.	.	.	.	.	.	.	.	.	0.550
13661702	.8	.	.7	.5	.	.	.	.	.	.	.	.	.	.	.	.	0.666
13661704	.7	.	.7	.5	.	.	.	.	.	.	.	.	.	.	.	.	0.633
13661705	.4	.	.	.6	.	.	.	.	.	.	.	.	.	.	.	.	0.500
13661800	.	.	.	.	.	.	.	.	.	.	.	.8	.	.5	.	.	0.650
14260100	.	.	.	.	.	.	.	.	.	.	.	.6	.4	.6	.	.	0.533
14260300	.	.	.	.	.	.	.	.	.	.	.	.3	.3	.	.	.	0.300
14250400	.	.	.	.	.	.	.	.	.	.	.	.3	.	.	.	.	0.300
14250800	.	.	.	.	.	.	.	.	.	.	.	.6	.6	.6	.	.	0.600
14261000	.	.	.3	.3	.3	.	.	.	.3	.3	.3	.3	.	.	.	.	0.300
14261100	.	.	.	.	.6	.6	.6	.6	.6	.6	.6	.	.	.6	.	.	0.600
14261200	.	.	.	.	.	.	.	.	.	.	.	.6	.6	.6	.	.	0.600
14310200	.	.	.	.	.	.	.	.	.	.	.	.4	.	.6	.	.	0.500

Figure 6. Sample System Support versus Task Matrix

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TASK	SYSTEMS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	AVERAGE ACROSS
13470200	0.	0.	0.	0.	0.6	0.7	0.7	0.7	0.6	1.2	0.6	1.6	0.6	0.	0.	0.	0.8109
13470300	0.	0.	0.	0.	0.9	0.	0.	0.	0.9	1.2	0.9	1.2	0.5	0.5	0.	0.	0.8753
13470400	0.	0.	0.	0.	0.6	0.7	0.7	0.7	0.6	0.6	0.6	1.6	0.6	0.6	0.	0.	0.7316
13670200	0.9	0.	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.9083
13670201	0.9	0.	0.9	0.9	0.9	0.	0.	0.	0.9	0.9	0.9	0.9	0.	0.9	0.	0.	0.8930
13671100	0.5	0.	0.5	0.5	0.5	0.5	0.5	0.	0.5	0.5	0.5	0.5	0.	0.5	0.	0.	0.5000
13671400	0.5	0.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.	0.	0.5000
13671500	0.9	0.	0.9	0.9	0.9	0.	0.	0.	0.9	0.9	0.9	0.9	0.	0.	0.	0.	0.8924
13671600	0.3	0.	0.3	0.3	0.3	0.	0.	0.	0.3	0.3	0.3	0.3	0.	0.	0.	0.	0.3000
13671700	0.5	0.	0.	0.	0.5	0.	0.	0.	0.5	0.5	0.5	0.3	0.	0.3	0.	0.	0.4429
13671701	0.1	0.	0.	0.	0.	0.	0.	0.	0.	0.5	0.	0.	0.	0.	0.	0.	0.3000
13680200	0.	0.	0.	0.	0.	0.	0.	0.	0.5	0.	0.	0.6	0.	0.6	0.	0.	0.5753
13680301	0.5	0.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.	0.5	0.5	0.5	0.	0.	0.5000
13680302	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.0	0.	2.0	0.	0.	2.0215
13680406	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.9	0.9	0.9	0.	0.	0.9023
13680600	0.5	0.	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.6	0.6	0.9	0.9	0.	0.	0.5909
13680700	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.	0.	0.4000
13680900	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.5	0.	0.6	0.	0.	0.5599
13681001	0.6	0.	0.6	0.6	0.6	0.7	0.7	0.7	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.6303
13681002	0.6	0.	0.6	0.6	0.6	0.7	0.7	0.7	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.6303
13681200	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.9	0.9	0.	0.9	0.	0.	0.9006
13681300	0.9	0.	0.9	0.	0.	0.9	0.	0.9	0.	0.	0.	0.9	0.	0.9	0.	0.	0.9046
13681401	0.9	0.	0.9	0.9	0.9	0.	0.	0.	0.9	0.	0.	0.	0.	0.	0.	0.	0.8907
13681403	0.9	0.	0.9	0.9	0.9	0.	0.	0.	0.9	0.	0.	0.	0.	0.	0.	0.	0.8907
13681502	0.9	0.	0.9	1.2	0.5	0.	0.	0.	0.9	0.	0.5	0.	0.	0.	0.	0.	0.8135
14670100	0.4	0.	0.	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.9	0.4	0.4	0.	0.	0.4402
14670200	0.	0.	0.5	0.5	0.5	0.7	0.5	0.	0.9	0.6	0.6	0.6	0.5	0.9	0.	0.	0.6181
14670300	0.6	0.	0.6	0.5	0.6	0.9	1.0	0.9	0.6	0.6	0.6	0.9	0.9	0.6	0.	0.	0.7375
14670400	0.9	0.	0.9	0.9	0.9	0.4	0.4	0.4	0.9	0.9	0.9	0.5	0.	0.	0.	0.	0.7234
14670500	0.9	0.	0.	0.9	0.9	0.	1.0	0.	1.2	0.	0.9	1.2	0.9	0.	0.	0.	0.9884
13660200	0.	0.	0.	0.9	0.9	0.	0.	0.	0.9	0.5	0.9	0.5	0.	0.5	0.	0.	0.7313
13660300	0.	0.	0.	0.	0.	0.	0.	0.	0.4	0.	0.4	0.6	0.6	0.9	0.	0.	0.5897
13660500	0.	0.	0.	0.	0.6	0.9	0.	0.	0.6	0.6	0.6	0.9	0.	0.	0.	0.	0.7181
13660600	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.9	0.9	0	0.	0.	0.9023
13660700	0.	0.	0.	0.	0.	0.7	0.7	0.7	0.4	0.4	0.4	1.2	0.9	1.	0.	0.	0.7277
13660800	0.	0.	0.	0.	0.	0.5	0.5	0.5	0.	0.	0.	1.2	0.5	1.2	0.	0.	0.7391
13660900	0.	0.	0.	0.	0.	0.5	0.	0.5	0.	0.	0.	0.9	0.5	0.9	0.	0.	0.6560
13661000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.3	0.5	0.4	0.	0.	0.4030
13661201	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.6	0.6	0.	0.	0.	0.	0.	0.6229
13661202	0.6	0.	0.	0.6	0.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.6171
13661203	0.	0.	0.	0.4	0.4	0.	0.	0.	0.4	0.4	0.	0.	0.	0.	0.	0.	0.4000
13661300	0.	0.	0	0.	0.	0.	0.	0.	0.	0.	0.	0.6	0.	0.6	0.	0.	0.6129
13661501	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.2	0.	1.6	0.	0.	1.4064
13661602	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.6	0.	1.2	0.	0.	1.4052
13661701	0.9	0.	0.5	0.5	0.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.5933
13661702	1.2	0.	0.9	0.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.8602
13661704	0.9	0.	0.9	0.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.7520
13661705	0.4	0.	0.	0.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.5141
13661800	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.2	0.	0.5	0.	0.	0.8540
14260100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.6	0.4	0.6	0.	0.	0.5419
14260300	0.	0.	0	0.	0.	0.	0.	0.	0.	0.	0.	0.3	0.3	0.	0.	0.	0.3000
14260400	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.3	0.3	0.	0.	0.	0.3000
14260800	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.6	0.6	0.6	0.	0.	0.6234
14261000	0.	0.	0.3	0.3	0.3	0.	0.	0.	0.3	0.3	0.3	0.3	0.	0.	0.	0.	0.3000
14261100	0.	0.	0.	0.	0.6	0.7	0.7	0.7	0.6	0.6	0.6	0.	0.	0.6	0.	0.	0.6360
14261200	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.6	0.6	0.6	0.	0.	0.6234
14310200	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.4	0.	0.6	0.	0.	0.5099

Figure 7. Sample Adjusted System Support versus Task Matrix

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TECH OBJS

TASK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
13470200	9	9		0	8		9	9	9	9				9	8			9	9	9																																				
13470300	0	9		9						8			8	8	8			8																											4										
13470400	9	0		9	7		9	9	9	9				9				9	7	9																															6								
13670200											8		8											4												4																						
13670201											6		6	4	5																																										
13671100													8		3																																										
13671400	3				3						3		3					3																																					
13671500			2	3								3	4				4																																						
13671600	3											9	6		2																																										
13671700	3			3	3	3				3	3		6		2																				4						4	2																
13671701	3			3		3						0	5																																										
13680200		0																												4		7																	0										
13680301					9	7		7	7										9	0	5																																				
13680302	3	3							7				7					0																																						
13680406									8	3								6								7																							0			0								
13680600						3												6		0																																				
13680700	2				6	6	0	6	0	3			6					6	4	2																										6										
13680900									5					7				6	6																											6										
13681001					6	5				6				6					6																																						
13681002					6	6				6				6					6																																						
13681200																		6																																						
13681300	6			6			9	9	9		7		6					9							7	7						6												6		7	9										
13681401	3				5	9					6		6																																									
13681403						8	6				6			4																																										
13681502						4					2		2																																	3										
14670100	7				8	6		6	6	5	7	0	7					9	9																										6	7	7										
14670200	6				6	6		6	6	5	4	0	9					6	6																										5	5										
14670300	6				6	6		6	6	5		0	9					6	6																									6	6	6	5										
14670400	8				5	7	6	6	6	5	6	9	0					6	6																										5	7										
14670500	7				7	7		6	6	5		0	9					7	7																										5	7	5										
13660200						5							4					5																4	8	8											5	5							4		
13660300																											7		7	8	9			5		5												7	6			7			7			
13660500																		6					8	8	8	6	5			5		5														5	5											
13660600													5					5				7	7	6	6	6	8	7		7		8																7	7						6			
13660700													6					5							5			8					9	8				7	6	6								8	8		6		7					
13660800									4				4																	4	7	5															5	7	6		5				5			
13660900												4	4			4									4					8	0	6	4		5		4										6	7	6										
13661000																														4	4	5	6				3									4										
13661201																						0																																			
13661202																																				4						5														
13661203																					8	8	5				5			4																										
13661300													4					4			8			3					4	5				5													5	5		6							
13661601				0									8					8											8				7													8	0	0										
13661602	7	9		0				7	8				9	7				8						7											8													C	C											
13661701																																										5	8	3														
13661702																																											7	8														
13661704																																											[illegible]	7														
13661705																																											5	8														
1366[illegible]00											4							5													5	6							4							9	6	6	5		5			5					
14260100																									5	5		6			8	5	8						7	7					5		7	6			5			3			
14260300																												5	4		4	6	4					5	4		8								6		5	4	5	5			
14260400																												3	4		5	5	4					1	6	4								4				4	5	4	4			
14260800																												3	6		7	9	8					7	5	7								5		7		6	6		6			
14261000																					1	1								1	3	4					5	4	5																			
14261100																						6	6		5	5																	6	6				6	6		6				6			6
14261200																									4						4					5	8	6									4		7	4	4	6	7	5			

Figure 8. Sam

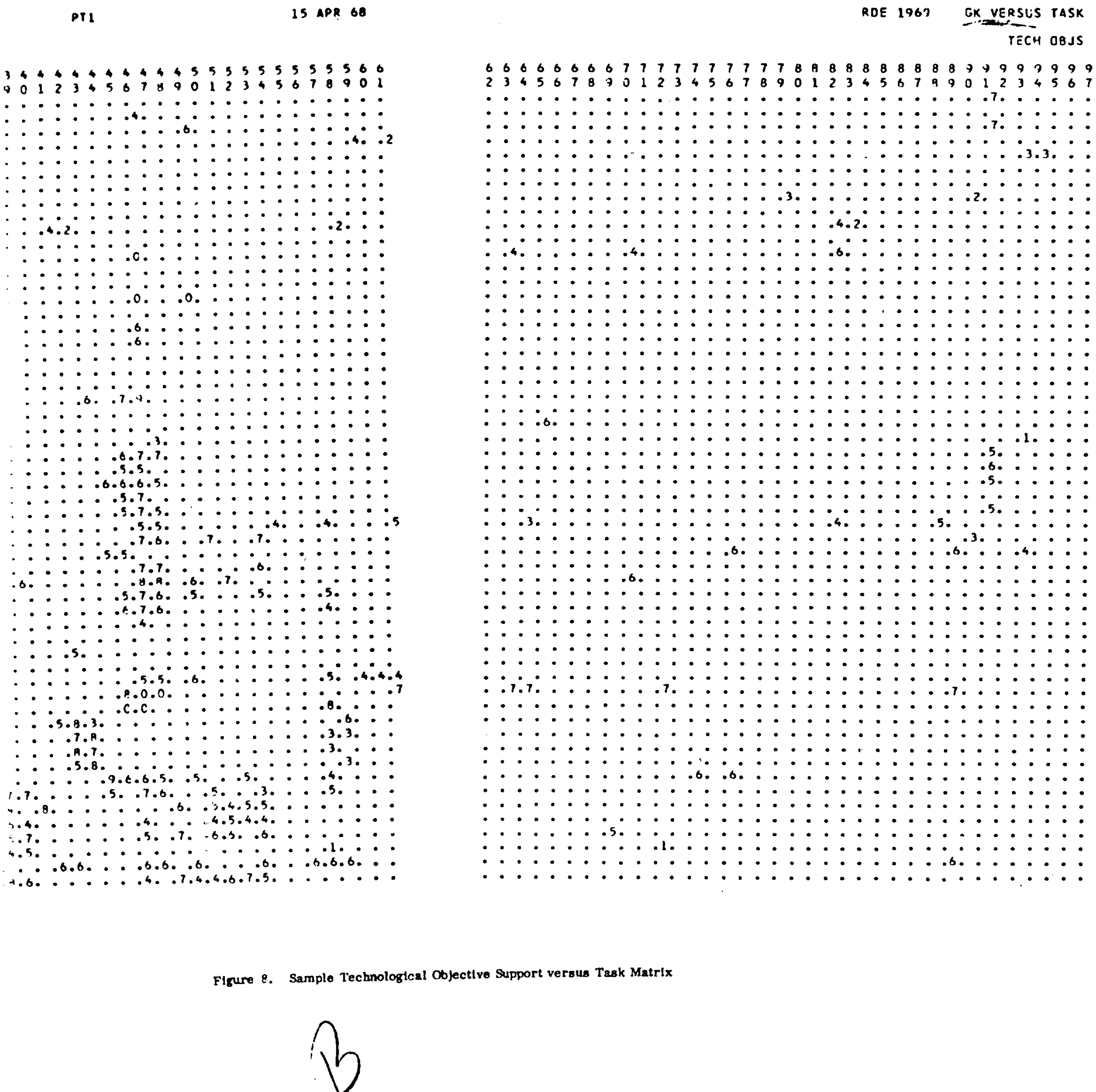

Figure 8. Sample Technological Objective Support versus Task Matrix

B

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TECH OBJS

67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	AVERAGE	TASK
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.873	13470200
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	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.247	13671500
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-us Task Matrix

15 APR 68

TASM	LIMITED WAR	SPECIAL AIR WARFARE	INTERDICTION	CLOSE SUPPORT	LOGISTICS
13470200	.3	.3	XX	XX	XX
13470300	.3	.3	XX	XX	XX
13470400	.3	.3	XX	XX	XX
13670200	.7	.7	XX	XX	XX
13670201	.7	.7	XX	XX	XX
13671100	.7	.7	XX	XX	XX
13671400	.5	.5	XX	XX	XX
13671500	.5	.6	XX	XX	XX
13671600	.5	.5	XX	XX	XX
13671700	.5	.5	XX	XX	XX
13671701	.6	.6	XX	XX	XX
13680200	.5	.5	XX		
13680301	.1	.1	XX	XX	XX
13680302	.1	.1	XX	XX	XX
13680406	.3	.3			
13680600	.5	.5	XX		XX
13680700	.6	.6		XX	XX
13680900	.3	.3		XX	
13681001	.7	.7	XX	XX	XX
13681002	.7	.7	XX	XX	XX
13681300	.6	.6		XX	XX
13681401	1.	1.	XX	XX	XX
13681403	1.	1.	XX	XX	XX
13681502	1.	1.	XX	XX	
14670100	.7	.7	XX	XX	XX
14670300	.7	.7	XX	XX	XX
14670400	.9	.9	XX	XX	XX
14670500	.9	.9	XX	XX	XX
13660200	.5		XX	XX	
13660500	.7	.5	XX		XX
13660700	.5		XX	XX	
13660800	.4		XX	XX	XX
13660900	.1	.3	XX		
13661201	.3	.3			XX
13661202	.7	.7	XX	XX	XX
13661203	.4	.4	XX	XX	XX
13661601	.5	.5	XX	XX	XX
13661602	.6	.5	XX	XX	XX
13661701	.7	.7	XX	XX	XX
13661702	.8	.8	XX	XX	XX
13661704	.9	.7	XX	XX	XX
13661705	.7	.6	XX	XX	XX
13661800	.1	.1		XX	XX
14261100	.7	.7	XX	XX	
14310300	.5	.3	XX	XX	XX
14310700	.7	.5	XX	XX	XX
14310900	.4		XX	XX	
14760100	.2	.2	XX	XX	XX
14760201	.7	.7	XX	XX	XX
14760202	.2	.2	XX	XX	XX
14760301	.7	.7	XX	XX	XX
14760302	.7	.7	XX	XX	XX
61900700	.4	.4	XX	XX	XX
61900302	.3	.3			XX
61900901	.2	.2			
61900902	.2	.2			
61901105	.7	.7	XX	XX	XX
61901200	.5	.5			

Figure 9. Sample Limited War Support versus Task Matrix

TASK	ASSOCIATED 1498 WORK UNITS									
13470200	002	003	005	006	007	008	009	010		
13470300	005	007	009	011	012	013				
13470400	002	003	005	006						
13670200	003									
13670201	001	007	009	010						
13671100										
13671400	001									
13671500										
13671600										
13671700										
13671701										
13680200	001	002								
13680301										
13680302										
13680405	005									
13680600	003	004	005							
13680700	002	[illegible]								
13680900	001									
13681001	001	002								
13681002	001	002								
13681200	001									
13681300	001									
13681401										
13681403										
13681502										
14670100	002	003	004	005						
14670200	008	009	010	011	012					
14670300	005	006	007	008						
14670400	006	008	004	009						
14670500	003	006	008	009						
13660200	002	003								
13660[illegible]0										
13660500	001	004	005							
13660600	003									
13660700	001	003	010	012	013	016	017	018		
13660800	002	006	007	008						
13660900	001	003	005	006						
13661000	001									
13661201	006	007								
13661202										
13661203										
13661300	005	007	008	009	011	012				
13661601	009	010	011	012	013					
13661602	008	011	2	013						
13661701										
13661702	004									
13661704										
13661705	001									
13661800										
14260100	001	002								
14260300										
14260400	004	005	006	008	009	010				
14260800	001	006								
14261000	001	002	003	004	005	006	007	008	009	[illegible]
14261100										
14261200	003	004	005	006	007	008	010	011		
14310200										
14310300	001									
14310700	004									
14310900	001	002								

Figure 1[illegible]. Sample 1498 Associated Work Units List

PRIORITY LIST FOR 1969 — 16 APR 68

RANK	TASK	TITLE	RL	C+S	ENGC	ENGIN	OBJ	RATIO	CUM C+S	CUM OBJ	CUM COST
1	13691403	COMBAT DAMAGES AND LOSSES DATA ANALYSIS	1	0.	0.	0.5	0.151	.02379	0.	0.151	6.3
2	82130903	V/STOL HANDLING QUALITIES	1	0.	0.	0.3	0.079	.02072	0.	0.230	10.2
3	13671701	MODEL DITCHING TESTS	1	10.0	0.	0.6	0.342	.01943	10.0	0.572	27.8
4	14760202	INTEGRATED AIRFRAME NOZZLE TESTING TECHNIQUES	1	1.0	0.	0.3	0.081	.01677	11.0	0.653	32.6
5	82220303	NUTATING INSTRUMENTS	2	200.0	0.6	0.5	2.061	.00963	211.0	2.715	246.6
6	82220301	LOW COST RESOLVERS	2	150.0	0.6	0.1	1.212	.00765	361.0	3.926	404.9
7	82260101	AUTOMATIC TERRAIN FOLLOWING	2	0.	0.6	0.	0.054	.00703	361.0	3.980	412.5
8	82190703	V/STOL GUST RESPONSE	2	200.0	1.6	0.	1.284	.00583	561.0	5.264	632.9
9	13520303	AERODYNAMIC PROPERTIES OF NOSE CAPSULE	2	0.	0.	1.4	0.094	.00528	561.0	5.358	650.7
10	82250803	MULTI-PARAMETER SELF-ORGANIZING CONTROL	1	0.	0.3	0.3	0.040	.00521	561.0	5.397	658.3
11	13590301	COMPOSITE CONSTRUCTION FOR FLIGHT VEHICLES	2	30.0	0.6	0.	0.183	.00488	591.0	5.581	695.9
12	13550200	PERFORMANCE ANALYSIS OF FLGHT VEHICLES	2	125.0	0.3	0.7	0.628	.00456	716.0	6.209	833.6
13	82190701	V/STOL STABILITY AND CONTROL PREDICTION MTHDS	2	160.0	1.2	0.8	0.821	.00443	876.0	7.030	1019.0
14	14250102	VISIBILITY FOR HYPERSONIC AND REENTRY VEHICLES	2	90.0	0.3	0.7	0.402	.00391	966.0	7.432	1121.7
15	13660900	HIGH SPEED AERODYNAMIC ANALYSIS METHODS	1	125.0	0.3	0.7	0.500	.00363	1091.0	7.931	1259.4
16	13690700	AIR CUSHION LDING GEAR SYS FOR ARSPCE VEHICLES	2	96.3	0.2	0.	0.331	.00337	1187.3	8.263	1357.6
17	14310700	APPLICTIONS ANALYSS OF ADVANCED VEHCLE CONCPTS	2	100.0	0.3	1.7	0.423	.00337	1287.3	8.685	1483.0
18	82220302	PULSED X-RAY POWER SUPPLY	1	75.0	0.4	0.0	0.260	.00324	1362.3	8.946	1563.4
19	13661602	SYNTHESIS OF HYPERSONIC VEHICLE POWERED	2	40.0	0.5	1.5	0.211	.00322	1402.3	9.156	1628.8
20	14260300	MAGNETO GASDYNAMIC TECHNIQUES	1	100.0	0.3	0.3	0.338	.00314	1502.3	9.495	1736.4
21	82260103	TACTICAL WEAPON DELIVERY	1	0.	0.	0.3	0.012	.00312	1502.3	9.507	1740.2
22	13090403	VIBRATION ACCOUSTIC EQUIVALENCE	2	80.0	0.3	0.7	0.285	.00307	1582.3	9.791	1832.9
23	82251102	SOLID STATE ELECTRICAL MULTIPLEX SYSTEM	2	190.0	0.6	0.	0.605	.00306	1772.3	10.397	2030.5
24	13671700	MANUEVER LOADS PROGRAMS	2	50.0	0.4	1.6	0.229	.00304	1822.3	10.626	2105.9
25	13581502	INTEGRAL STRUCTURAL ARMOR	2	200.0	0.4	1.0	0.655	.00301	2022.3	11.281	2323.7
26	82251101	FLY-BY-WIRE	2	92.2	0.5	0.3	0.287	.00283	2114.5	11.568	2425.3
27	13700602	PRED AN PREV OF FLIGT INDUCD DYNAMC LOD PRBLMS	2	250.0	1.0	1.6	0.794	.00280	2364.5	12.362	2708.3
28	13600305	EXPANDABLE TIRES AND NEW TIRE CONCEPTS	1	104.0	0.3	0.5	0.310	.00272	2468.5	12.672	2822.5
29	13591401	AIRCRAFT STRUCTURAL VULNERABILITY	1	46.8	0.3	0.5	0.149	.00265	2515.4	12.821	2878.8
30	82190705	V/STOL FLIGHT TEST TECHNOLOGY	2	200.0	0.4	1.2	0.556	.00252	2715.4	13.377	3099.1
31	13470300	STRUCTURAL TESTING CRITERIA	1	53.4	0.2	3.2	0.238	.00248	2768.8	13.615	3195.3
32	82191101	FLIGHT CONTROL OPTIMIZATION TECHNIQUES	2	200.0	1.0	0.	0.522	.00246	2968.8	14.138	3408.0
33	82220901	SOFZ FLM TECH APPLIED TO INERTIAL SENSORS	1	50.0	0.3	0.1	0.128	.00235	3018.8	14.266	3462.6
34	13651300	LOW SPEED AERODYNAMIC ANALYSIS METHODS	2	150.0	0.5	1.5	0.411	.00234	3168.8	14.677	3638.0
35	13150200	NEW BEARING DESIGNS	2	50.0	0.2	1.4	0.156	.00222	3218.8	14.832	3708.3
36	82221002	MONOPULSE FLIGHT REFERENCE TECHNIQUE	2	0.	0.	0.6	0.017	.00219	3218.8	14.849	3715.9
37	13620304	AERO MECHANICAL PROPERTIES OF EJECTION SEATS	2	0.	0.	1.8	0.050	.00219	3218.8	14.899	3738.8
38	14670400	STRUCTURAL FATIGUE ANALYSIS	2	150.0	0.5	1.3	0.372	.00215	3368.8	15.271	3911.7
39	14710201	JET AND FAN NOISE	2	200.0	0.6	1.0	0.472	.00214	3568.8	15.743	4132.0
40	60650200	TEXTILE PARACHUTE SIMILARITY LAWS	2	24.0	0.2	1.4	0.093	.00210	3592.8	15.836	4176.3
41	13691300	DISPERSION STRENGTHENED METAL STRUCTURES	2	350.0	0.8	1.2	0.777	.00207	3942.8	16.613	4551.7
42	13090801	ACCELERATED ENVIRONMENTAL TEST METHODS	2	117.0	0.3	3.7	0.347	.00207	4059.8	16.960	4719.5
43	14250101	AEROSPACE VEHICLE CREW STATION CRITERIA	2	150.0	0.4	0.6	0.324	.00199	4209.8	17.284	4882.2
44	14670500	COMPUTERIZED STRUCTURAL ANALYSIS METHODS	2	180.0	0.9	1.5	0.408	.00194	4389.8	17.692	5092.7
45	13660600	HYPERSONIC BOUNDARY LAYER PROPERTIES	2	150.0	0.4	0.6	0.311	.00191	4539.8	18.003	5255.4
46	14670200	THERMOELASTIC STRUCTURAL ANALYSIS	2	200.0	1.0	1.6	0.411	.00176	4739.8	18.413	5488.4
47	14720400	OPTIMIZATION OF DYNAMICS DATA	2	120.0	0.6	1.0	0.241	.00172	4859.8	18.655	5628.7
48	14250301	PASSIVE DEFENSE FOR PERSONNEL PROTECTION	2	150.0	0.8	2.2	0.319	.00170	5009.8	18.974	5816.8
49	14710203	SOUNDPROOFING TECHNIQUES	2	75.0	0.2	0.6	0.143	.00168	5084.8	19.117	5902.0
50	61931200	HEAD-UP DISPLAY DEVELOPMENT	2	150.0	0.4	0.2	0.264	.00167	5234.8	19.380	6059.6
51	13571400	STUCTURAL LOAD CRITERIA SIMULATION TECHNIQUES	2	46.6	0.1	0.4	0.087	.00166	5281.4	19.467	6112.1
52	82260102	MULTIPLE FEEDBACK FR LATERAL-DIRECTIONAL CNTRL	2	250.0	0.6	0.	0.414	.00161	5531.4	19.881	6369.8
53	13660800	AERODYNMIC CHARCTRISTCS OF HIGH SPD CONFGRTINS	2	200.0	0.5	1.5	0.358	.00159	5731.4	20.239	6595.2
54	14310900	TRAJECTORY AND MOTION ANALYSIS OF FLT VEHICLES	2	0.	0.	4.0	0.081	.00159	5731.4	20.320	6646.0
55	13681002	INVESTIGATION JOINTS CUTOUTS DESIGN CONCEPTS	2	400.0	1.2	0.2	0.657	.00157	6131.4	20.977	7063.7
56	14310200	PRELIMINARY VEHICLE SYNTHESIS	1	0.	0.	0.3	0.006	.00155	6131.4	20.982	7067.6
57	13470200	MEASUREMENT OF STRUCTURAL RESPONSE	1	100.0	0.6	3.8	0.235	.00151	6231.4	21.218	7223.4
58	13150400	WING PIVOT BEARINGS	2	150.0	0.4	1.2	0.254	.00149	6381.4	21.471	7393.8
59	82221205	INTEGRATED DATA SYSTEM-SIGNAL FORMAT	2	300.0	0.4	0.4	0.458	.00148	6681.4	21.929	7703.9
60	14700104	RECIPROCATING CRYO REFRIGERATORS	2	175.0	0.7	3.1	0.327	.00146	6856.4	22.256	7927.2
61	82221303	HIGH Z HIGH TEMPERATURE SEMICONDUCTOR	1	67.7	0.3	0.3	0.107	.00144	6924.1	22.363	8001.8
62	61451700	SPACECRAFT THERMAL CONTROL	2	43.0	0.4	2.1	0.107	.00144	6967.2	22.469	8076.1
63	13520401	HIGH SINK RATES ESCAPE CAPABILITY	2	350.0	0.7	0.9	0.531	.00143	7317.2	23.000	8445.4
64	13550300	LOW DENSITY VISCOUS GASDYNAMICS	2	100.0	0.5	0.5	0.152	.00135	7417.2	23.153	8559.1
65	61901105	VISTOL FLIGHT DIRECTOR COMPUTER DEVELOPMENT	2	100.0	0.2	0.4	0.145	.00135	7517.2	23.298	8666.7

46	1467[illegible]	THERM[illegible]									
47	1472[illegible]	OPTIMIZATION OF DYNAMICS DATA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.00172	485[illegible]	18.[illegible]55	5628.7
48	14250301	PASSIVE DEFENSE FOR PERSONNEL PROTECTION	2	150.[illegible]	[illegible]	2.2	[illegible]	.00170	5000.[illegible]	18.974	5816.8
49	14710203	SOUNDPROOFING TECHNIQUES	2	75.0	0.2	0.6	0.143	.00168	5084.8	19.117	5902.0
50	61901200	HEAD-UP DISPLAY DEVELOPMENT	2	150.0	0.4	0.2	0.264	.00167	5234.8	19.380	6059.6
51	13571400	STUCTURAL LOAD CRITERIA SIMULATION TECHNIQUES	2	46.6	0.1	0.4	0.087	.00166	5281.4	19.467	6112.1
52	82260102	MULTIPLE FEEDBACK FR LATERAL-DIRECTIONAL CNTRL	2	250.0	0.6	0.	0.414	.00161	5531.4	19.881	6369.8
53	13660803	AERODYNMIC CHARCTRISTICS OF HIGH SPD CONFGRTINS	2	200.0	0.5	1.5	0.358	.00159	5731.4	20.239	6595.2
54	14310900	TRAJECTORY AND MOTION ANALYSIS OF FLT VEHICLES	2	0.	0.	4.0	0.081	.00159	5731.4	20.320	6646.0
55	13681022	INVESTIGATION JOINTS CUTOUTS DESIGN CONCEPTS	2	400.0	1.2	0.2	0.657	.00157	6131.4	20.977	7063.7
56	14310200	PRELIMINARY VEHICLE SYNTHESIS	1	0.	0.	0.3	0.006	.00155	6131.4	20.982	7067.6
57	13470200	MEASUREMENT OF STRUCTURAL RESPONSE	1	100.0	0.6	3.8	0.235	.00151	6231.4	21.218	7223.4
58	13150400	WING PIVOT BEARINGS	2	150.0	0.4	1.2	0.254	.00149	6381.4	21.471	7393.8
59	82221205	INTEGRATED DATA SYSTEM-SIGNAL FORMAT	2	300.0	0.4	0.4	0.458	.00148	6681.4	21.929	7703.9
60	14700104	RECIPROCATING CRYO REFRIGERATORS	2	175.0	0.7	3.1	0.327	.00146	6856.4	22.256	7927.2
61	82221303	HIGH Z HIGH TEMPERATURE SEMICONDUCTOR	1	67.7	0.3	0.3	0.107	.00144	6924.1	22.363	8001.8
62	61451700	SPACECRAFT THERMAL CONTROL	2	43.0	0.4	2.1	0.107	.00144	6967.2	22.469	8076.1
63	1352040[illegible]	HIGH SINK RATES ESCAPE CAPABILITY	2	350.0	0.7	0.9	0.531	.00143	7317.2	23.000	8446.4
64	13650300	LOW DENSITY VISCOUS GASDYNAMICS	2	100.0	0.5	0.5	0.152	.00135	7417.2	23.153	8559.1
65	61901105	VISTOL FLIGHT DIRECTOR COMPUTER DEVELOPMENT	2	100.0	0.2	0.4	0.145	.00135	7517.2	23.298	8666.7
66	13670200	AEROSPACE VEHICLE LOADS CRITERIA	2	163.5	1.4	1.4	0.266	.00134	7680.7	23.563	8864.8
67	14710202	SONIC LOAD AND RESPONSE RECORDER	2	100.0	0.4	0.6	0.149	.00132	7780.7	23.712	8977.5
68	82191000	PILOT-VEHICLE DYNAMIC ANALYSIS TECHNIQUES	2	450.0	2.0	3.0	0.648	.00126	8230.7	24.361	9491.0
69	14710103	ACOUSTIC FATIGUE	2	350.0	1.0	3.8	0.516	.00126	8580.7	24.877	9902.0
70	13700500	PREDICTION AND CONTROL OF STRUCTURAL VIBRATION	2	225.0	0.8	7.2	0.405	.00124	8805.7	25.282	10228.6
71	14260100	HYPERSONIC TUNNEL STUDIES	1	29.0	0.5	4.0	0.107	.00123	8834.7	25.389	10315.0
72	61461500	AIRCRAFT THERMAL CONTROL	2	375.0	1.2	2.8	0.523	.00123	9209.7	25.911	10740.8
73	13470400	THERMAL APPLICATION AND CONTROL	2	135.0	0.5	7.5	0.290	.00123	9344.7	26.202	10977.4
74	82250705	FAILURE DATA COMPILATION AND REDUCTION	1	75.0	0.3	0.	0.094	.00119	9419.7	26.295	11056.2
75	82190800	V/STOL FLIGHT CONTROL OPTIMIZATION	2	200.0	0.5	0.3	0.250	.00119	9619.7	25.546	11266.3
76	61461300	TRACE CONTAMINANT MANAGEMENT	1	0.	0.	0.5	0.007	.00112	9619.7	26.553	11272.7
77	13150100	AIRFRAME BEARING DESIGNERS HANDBOOK	1	78.0	0.3	0.	0.092	.00112	9697.7	26.645	11354.5
78	13671100	STRUCTURAL FATIGUE DESIGN CRITERIA	2	110.0	0.4	0.4	0.134	.00111	9807.7	26.778	11474.7
79	14720300	DEVLPMNT OF DYNAMIC MEASURMNT AND ANALYS SYSTM	2	160.0	0.4	0.4	0.189	.00111	9967.7	26.967	11644.8
80	13090302	VACUUM MEASUREMENT TECHNIQUES	2	15.0	0.	0.8	0.026	.00105	9982.7	26.994	11670.0
81	82220702	AR DTA SNSING FR V/STL SUB ND SPRSNIC ARCRFT	2	200.0	0.6	0.4	0.21[illegible]	.00102	10182.7	27.210	11882.7
82	82221001	IMAGE MOTION SENSING	2	190.0	0.4	0.2	0.199	.00101	10372.7	27.409	12080.3
83	82220906	MULTIFUNCTION SENSOR	2	100.0	0.4	0.2	0.108	.00100	10472.7	27.517	12187.9
84	82190502	HANDLING QUALITIES INVESTIGATION NEW	1	100.0	0.3	0.3	0.107	.00099	10572.7	27.624	12295.5
85	13520305	SEPARATION DYNAMICS OF EJECTION SEATS	2	65.0	0.3	3.9	0.114	.00096	10637.7	27.738	12413.9
86	13690900	DESIGN TECHNIQUES FOR BRITTLE STRUCTURES	1	100.0	0.3	0.2	0.100	.00094	10737.7	27.838	12520.2
87	13630700	JOINT DESIGN AND EVALUATION	2	375.0	1.4	2.0	0.360	.00086	11112.7	28.198	12938.4
88	14310300	APPLCTN OF MTHEMTCL TCHNQS TO FLGHT PTH ANLYSS	1	100.0	0.3	0.2	0.087	.00082	11212.7	28.285	13044.8
89	14760100	ANLYTCAL INVES OF INLT AND EXHUST NZZLE FLW FL	1	100.0	0.3	0.2	0.085	.00078	11314.7	28.370	13153.1
90	13660700	HYPERSONIC GASDYNAMIC HEATING	2	250.0	0.7	7.3	0.271	.00077	11564.7	28.640	13504.7
91	82220205	CCS FOR VEHICLE LAUNCHED MISSILES	2	250.0	0.6	0.2	0.194	.00075	11814.7	28.835	13764.9
92	82250508	DIRECT LIFT CONTROL	1	200.0	0.4	0.	0.152	.00074	12014.7	28.986	13970.6
93	13090803	COMBINED ENVIRONMENT TEST TECHNIQUES	2	50.0	0.6	1.4	0.055	.00073	12064.7	29.042	14046.0
94	44370500	NOISE SOURCE DEVELOPMENT	2	170.0	0.6	4.4	0.170	.00073	12234.7	29.212	14279.5
95	82260404	FLUIDIC MISSILE CONTROL SYSTEM	2	300.0	0.8	0.2	0.213	.00068	12534.7	29.425	14592.2
96	82220902	FERROMAGNETIC FLUID INSTRUMENTS	1	50.0	0.3	0.1	0.037	.00067	12584.7	29.461	14646.7
97	60650500	SUPERSONIC DECELERATOR OPERATING PHENOMENA	2	90.0	0.3	0.9	0.068	.00065	12674.7	29.530	14752.0
98	61900502	IMPRVD PRMARY CNTROLLERS FR LRG AIRCRAFT	1	180.0	0.3	0.	0.119	.00065	12854.7	29.649	14935.8
99	82221203	STRAPDOWN CONTROL DATA COMPUTER	2	200.0	0.4	0.2	0.132	.00064	13054.7	29.781	15143.4
100	14261100	SUPERSONIC GASDYNMCS FACLTY DEV AND TECHNIQUES	1	28.3	0.1	0.1	0.020	.00063	13083.0	29.801	15174.8
101	13681200	CRYOGENIC TANKAGE	1	25.0	0.	0.5	0.020	.00062	13108.0	29.820	15206.1
102	13661601	SYNTHESIS OF HYPERSONIC VEHICLES HIGH LD	2	125.0	0.6	2.2	0.100	.00062	13233.0	29.920	15366.7
103	82250701	RLIBLTY PRDCTON ND VERIFICATION TECHNIQUES	1	100.0	0.3	0.2	0.066	.00062	13333.0	29.986	15473.0
104	82240300	PRSSURE MEASRNG TECH IN EXTREME ENVIRONMENTS	1	60.0	0.2	0.1	0.039	.00061	13393.0	30.025	15537.5
105	82250601	VTOL OPTIMAL CONTROL	2	250.0	0.6	0.	0.152	.00059	13643.0	30.177	15795.1
106	13661000	MHD APPLICATIONS	2	50.0	0.3	0.3	0.034	.00059	13693.0	30.211	15852.7
107	82190203	STABILITY AND CONTROL ANALYSIS ND DTA DVLPMNT	2	180.0	0.5	0.5	0.110	.00057	13873.0	30.321	16045.4
108	82190103	AROELSTC EFFCTS ON STABILITY AND CONTROL	2	250.0	0.5	0.3	0.148	.00057	14123.0	30.469	16305.6
109	82220703	AR DTA SNSNG FR HPRSNIC ND R-NTRY VEHICLES	2	120.0	0.4	0.2	0.067	.00053	14243.0	30.536	16433.2
110	82190206	STORE STBILTY AND CONTRL CHARACTERISTICS	2	350.0	0.6	0.6	0.190	.00052	14593.0	30.727	16798.4
111	13680406	ADV TANTALUM ALLOY STRUCTURE	1	258.0	0.5	0.	0.137	.00052	14851.0	30.864	17062.8
112	82250806	SLF-ORGNIZNG CONTRL FR AR-LAUNCHED MISSILES	2	130.0	0.3	0.5	0.072	.00051	14981.0	30.936	17232.9
113	82221304	PLASMA DIAGNOSTICS AND GENERATION	2	40.0	0.2	0.6	0.025	.00050	15021.0	30.961	17253.1
114	82221202	SOLID STATE AIR DATA COMPUTER	2	170.0	0.3	0.1	0.087	.00050	15191.0	31.048	17428.2
115	82190501	HANDLING QUALITIES REQUIREMENT ESTABLISHED	1	208.1	0.5	0.1	0.107	.00049	15399.1	31.155	17644.5
116	60650106	DISCRETIONARY PERSONNEL DESCENT SYSTEM	2	240.0	0.8	2.0	0.133	.00048	15639.1	31.288	17920.1

Figure 11. Sample Priority List

TRUCTURES DIVISION ANNUAL OUTPUT 1969 16 APR 68

PROJECT 1347 STRUCTURAL TESTING OF FLIGHT VEHICLES KEARNEY W E 54580

	TASK	TITLE	CL 68	CL 69	OBJ	C+S	ENGC	ENGIH	BEST RL	OVERALL RANK
NONSEL	0200	MEASUREMENT OF STRUCTURAL RESPONSE	.50	.50	0.2352	100.00	0.60	3.80	1	57
NONSEL	0300	STRUCTURAL TESTING CRITERIA	.60	.60	0.2383	53.44	0.16	3.21	1	31
NONSEL	0400	THERMAL APPLICATION AND CONTROL	.50	.50	0.2901	135.00	0.50	7.50	2	73
			PROJ	TOTAL	0.	0.	0.	0.		

Figure 12. Sample Annual Report

STRUCTURES DIVISION ANNUAL OUTPUT .949 16 APR 68

PROJECT 1347 STRUCTURAL TESTING OF FLIGHT VEHICLES KEARNEY V E 54680

	TASK	TITLE	CL 68	CL 69	OBJ	C+S	ENGC	ENGIH	BEST RL	OVERALL RANK
NONSEL	0200	MEASUREMENT OF STRUCTURAL RESPONSE	.50	.5C	0.2352	100.00	0.60	3.80	1	57
NONSEL	0300	STRUCTURAL TESTING CRITERIA	.6C	.6C	0.2383	53.44	0.16	3.21	1	31
NCNSEL	0400	THERMAL APPLICATION AND CONTROL	.50	.5C	0.2901	135.00	0.50	7.50	2	73
			PROJ	TOTAL	0.	0.	0.	0.		

Figure 12. Sample Annual Report

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                                          RDE  FY  1969   FINAL  REPORT                                                          16 APR 68
DIVISION  1        TASK  13470200        MEASUREMENT  OF STRUCTURAL RESPONSE                                        AR   27

                    SUPPORT  OF  TECH  OBJS                                              SUPPORT  OF  SYSTEMS
TO    001 002 004 005 007 008 009 010 014 015 018 019 020 091 101        SYS  05 06 07 08 09 10 11 12 13
SUP    .9  .9  .0  .8  .9  .9  .9  .9  .9  .8  .9  .9  .9  .7  .8        SUP  .6 .6 .6 .6 .6 .8 .6 .9 .6 .  .  .  .  .  .
TK    002 009 005 002 006 002 003 003 003 002 011 003 004 006 004         TJ  02 02 02 02 04 02 02 04 03

                                                      HISTORY                                                       ASSOCIATED  1498
             65         66         67         68         69         70         71         72         73              WORK  UNITS
   CL       .20        .30        .40        .50        .50        .50        .50        .60        .70         002    003    005    006    007
   C+S     85.0       93.0       75.0      115.0         0.         0.         0.      100.0      100.0         008    009    010
   ENGC                                                  0.         0.         0.        0.6        0.6
  ENGIH                                                  0.         0.         0.        3.8        3.8
   RL                                                    1          1          1          1          1



DIVISION  1        TASK  13470300        STRUCTURAL  TESTING  CRITERIA                                              AR   16

                    SUPPORT  OF  TECH  OBJS                                              SUPPORT  OF  SYSTEMS
TO    001 002 004 010 013 014 015 018 046                                SYS  05 09 10 11 12 13 14
SUP    .   .9  .9  .8  .8  .8  .8  .8  .4  .  .  .  .  .  .              SUP  .7 .7 .8 .7 .8 .5 .5 .  .  .  .  .  .  .  .
TK    002 009 005 003 002 003 002 011 006                                 TJ  02 04 02 02 04 03 04

                                                      HISTORY                                                       ASSOCIATED  1498
             65         66         67         68         69         70         71         72         73              WORK  UNITS
   CL       .40        .40        .50        .60        .60        .80        .80        .80        .80         005    007    009    001    012
   C+S      4.0      213.0       56.0       75.0         0.         0.         0.         0.         0.         013
   ENGC                                                  0.         0.         0.         0.         0.
  ENGIH                                                  0.         0.         0.         0.         0.
   RL                                                    1          1          1          1          1
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Figure 13. Sample Final Report

SYS SUPPORT 5 FY 1969 PROFILES 16 APR 68

TASK	SUP	TITLE	CONFIDENCE LEVEL 2.........3.........4.........5.........6.........7.........8
13470303	0.7	STRUCTURAL TESTING CRITERIA	8 0
13670200	0.7	AEROSPACE VEHICLE LOADS CRITERIA	8
13670201	0.7	AEROSPACE VEHICLE LOADS CRITERIA	8
13671503	0.7	AIRLOADS AND LOADS DISTRIBUTION	8
13681401	0.7	AIRCRAFT STRUCTURAL VULNERABILITY	8 0
13681403	0.7	COMBAT DAMAGES AND LOSSES DATA ANALYSIS	8 9
14670403	0.7	STRUCTURAL FATIGUE ANALYSIS	8 1
14670503	0.7	COMPUTERIZED STRUCTURAL ANALYSIS METHODS	8 2 3
13660203	0.7	PERFORMANCE ANALYSIS OF FLGHT VEHICLES	9 9 0
14760201	0.7	INVES OF INLT AND EXHST NZZLE COMPT PERFRMANCE	8
14760301	0.7	INVESTIGATION OF AIRFRAME INLET INTERACTION	8
14760302	0.7	EXPERMTL INTGRTED AIRFRME NOZZLE PERFORMANCE	8
61901105	0.7	VISTOL FLIGHT DIRECTOR COMPUTER DEVELOPMENT	8 3
82190103	0.7	AROELSTC EFFCTS ON STABILITY AND CONTROL	9
82190203	0.7	STABILITY AND CONTROL ANALYSIS ND DTA DVLPMNT	8 3
82190204	0.7	AERODYNAMIC CONTROLS	8
82190205	0.7	STORE STBILTY AND CONTRL CHARACTERISTICS	9 2
82190403	0.7	FLIGHT CONTROL SYSTEMS ANALYSIS	8
82190501	0.7	HANDLING QUALITIES REQUIREMENT ESTABLISHED	8
82190502	0.7	HANDLING QUALITIES INVESTIGATION NEW	8 2
82220201	0.7	LOW CST FLGHT RFNCE STABILIZATION SYSTEM	8
82220202	0.7	ADVNCD DTA SYSTMS FR LOW ND HGH SPD AIRCRAFT	8
82220301	0.7	LOW COST RESOLVERS	8 9 0
82221202	0.7	SOLID STATE AIR DATA COMPUTER	8
82221205	0.7	INTEGRATED DATA SYSTEM-SIGNAL FORMAT	8 3
82240200	.7	STORED ENERGY MANAGEMENT TECHNOLOGY	8
82240601	.7	PROPELLANT MASS GAGING	8
82240602	0.7	PROPELLANT FLOW RATE MEASUREMENT	3
82250509	0.7	DIRECT LIFT CONTROL	8
82250803	0.7	MULTI-PARAMETER SELF-ORGANIZING CONTROL	8 9
82251002	0.7	CNTPL ACTATON TECH/INTGRTD SRVO ACTATR PCKAGE	3
82251101	0.7	FLY-BY-WIRE	8 C
82251102	0.7	SOLID STATE ELECTRICAL MULTIPLEX SYSTEM	8
82251103	0.7	MULTIPLEXED FLIGHT CONTROL SYSTEM	8
82260102	0.7	MULTIPLE FEEDBACK FR LATERAL-DIRECTIONAL CNTRL	8 1 3
82260103	0.7	TACTICAL WEAPON DELIVERY	80
13700301	0.7	UNSTEADY AERO METHODS DEVLPMNT AND VERIFCATION	8
13700303	0.7	AROTHERMOLASTIC INSTABLTY PREDCTON AND CRTERIA	8
13700500	.7	PREDICTION AND CONTROL OF STRUCTURAL VIBRATION	9
13700801	0.7	PRED AN PREV OF GRND INDUCD DYNAMC LOD PROBLMS	8
13700802	0.7	PRED AN PREV OF FLIGT INDUCD DYNAMC LOD PRBLMS	8 1
14710103	0.7	ACOUSTIC FATIGUE	3
14710201	0.7	JET AND FAN NOISE	8 1
44370100	0.7	SONIC FACILITY DEVELOPMENT	8
44370500	0.7	NOISE SOURCE DEVELOPMENT	8
13090801	0.7	ACCELERATED ENVIRONMENTAL TEST METHODS	8
13090803	0.7	COMBINED ENVIRONMENT TEST TECHNIQUES	8
13090903	0.7	SHOCK TECHNOLOGY	8
13150403	0.7	WING PIVOT BEARINGS	8
13690302	0.7	LIGHT WEIGHT LANDING GEAR	8
14700104	0.7	RECIPROCATING CRYO REFRIGERATORS	8
14700203	0.7	CRYOGENIC BEARINGS AND SEALS	8
60650906	0.7	AIRCREW RESCUE CAPABILITY	8
61461403	0.7	OXYGEN CONCENTRATION AND SUPPLY	8
61461503	0.7	AIRCRAFT THERMAL CONTROL	8

Figure 14. Sample System Profile

AFFDL-EXISTING FACILITIES   RDE 1969 FACILITY UTILIZATION REPORT   16 APR 68

			HOURS - BY FISCAL YEAR				
			69	70	71	72	73
0100	WIND TUNNEL, HYPERSONIC (GAS-DYNAMIC - 50 MW)						
13661601	SIERON T. DECAMP R.	55006	0	0	0	30	0
	TOTAL HOURS		0	0	0	30	0
0200	WIND TUNNEL, HYPERSONIC (GAS-DYNAMIC - 4 MW)						
13660300	SHEREDA DON	52630	0	0	100	0	0
13661502	SIERON T. DECAMP R.	55006	0	0	0	8	0
14260300	HILLSAMER MAX E.	53061	0	0	0	500	0
	TOTAL HOURS		0	0	100	508	0
0300	WIND TUNNEL, SUPERSONIC (GAS-DYNAMIC - 2 FT)						
13661602	SIERON T. BURNETT D.	55006	0	50	0	0	0
	TOTAL HOURS		0	50	0	0	0
0400	WIND TUNNEL, HYPERSONIC (GAS-DYNAMIC - PEBBLE BED)						
13660600	MCELDERRY EDWIN	52630	0	0	120	100	0
13660700	NEUMANN RICHARD D.	52701	0	0	0	40	0
13660800	MARTINEZ CONRAD JR.	52630	0	0	0	180	120
13660900	DAHLEM VALENTINE	52630	0	240	0	0	0
13661601	SIERON T. DECAMP R.	55006	0	0	0	16	0
	TOTAL HOURS		0	240	120	336	120
0500	STRUCTURES TEST FACILITY (AEROSPACE VEHICLES)						
13470200	FEARNOW D O	54680	0	0	0	1000	300
13470300	JOHNSTON WM R	54680	0	4080	0	0	0
13470400	NOBLE ROBERT A	52067	0	0	0	0	700
13681300	RAMSEY C	55349	0	0	300	0	0
14670200	MADDUX GENE E	55689	0	0	0	0	500
14670400	WOOD HOWARD A	55689	0	0	2500	0	0
	TOTAL HOURS		0	4080	2800	1000	1500
0501	INDUCTION HEATING (RF) FACILITY						
13470400	NOBLE ROBERT A	52067	0	0	0	0	400
	TOTAL HOURS		0	0	0	0	400
0502	STRUCTURES TEST SENSOR DEVELOPMENT FACILITY						
13470200	FEARNOW D O	54680	0	0	0	350	300
	TOTAL HOURS		0	0	0	350	300
0600	ENVIRONMENTAL RESEARCH LABORATORY						
13470400	NOBLE ROBERT A	52067	0	0	0	0	300
	TOTAL HOURS		0	0	0	0	300

Figure 15. Sample Facility Utilization Report

SECTION IV
PROGRAMMING GUIDE

1. RUNNING THE PROGRAM

The following diagrams are included to facilitate proper setup of the program decks. The edit program is run first, and must execute with no error messages before a master file is built.

Following the successful completion of EDIT, the entire RDE program can be run in one pass. General instructions to the operator should be to mount the master file on logical 1, and scratch tapes on logical 7, 8, and 11. Note that 2 data cards precede the 90 sort control cards, and that the Facility titles are entered as data following the FACT routine.

2. PROGRAMMING NOTES

As with any program, certain pecularities arise within the code that can cause not only different results when running check cases, but also can cause program hangup. This section is supposed to resolve some of these difficulties.

1. To preclude the difficulties encountered with INTEGER type statements, all variables are implicitly typed. In addition, integer names are used for alphameric data.

2. If a variable is used in more than one routine, its Fortran name will always be the same in all the routines and COMMON statements.

3. The I-Format on this compiler allows left justified integers which do not necessarily fill the field. This fact is reflected in the way the input forms are designed.

4. EXEC calls a routine DATE, which, again on this system, returns in 2 words the day, month, and year. It is suggested that, if this feature is not available, a function DATE could be written which would read in this information. The date is printed on each report so that the user can always determine which is the latest production run.

EDIT

CARD

ARRANGEMENT

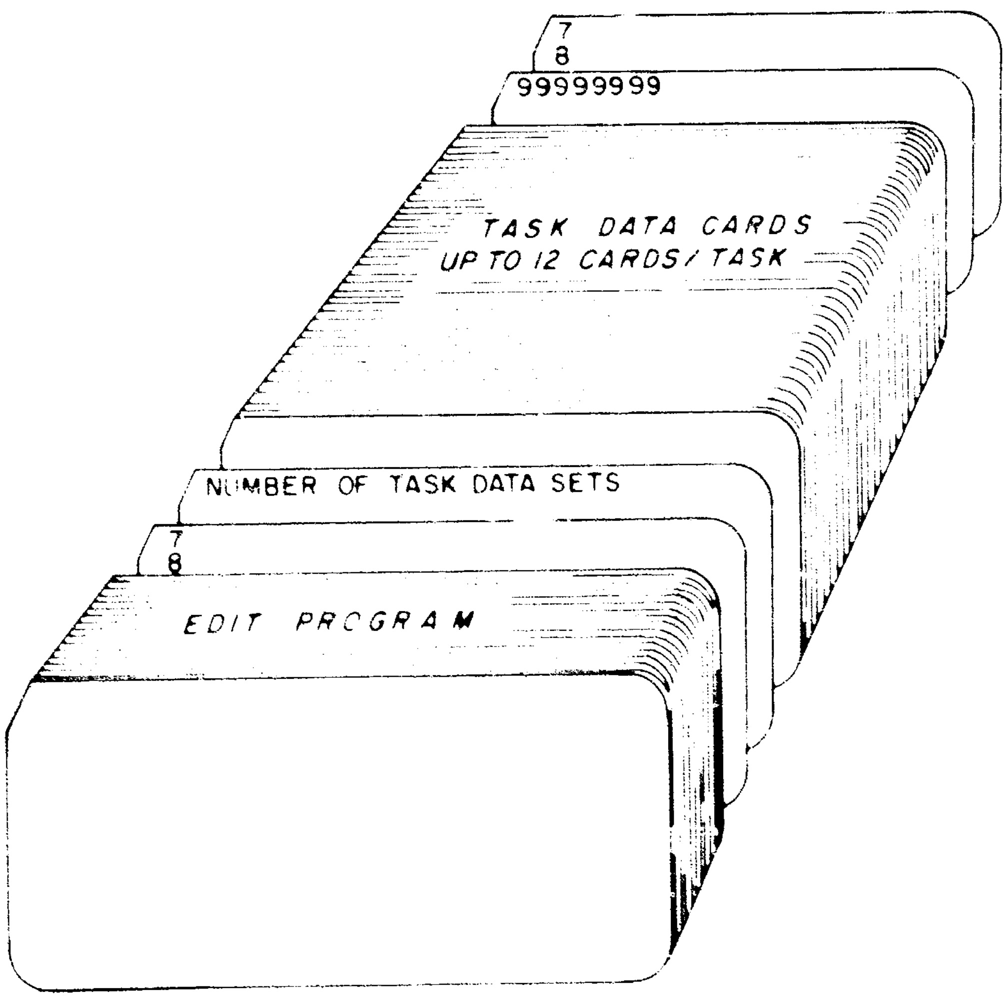

Figure 16. EDIT Deck Setup

RDE

CARD

ARRANGEMENT

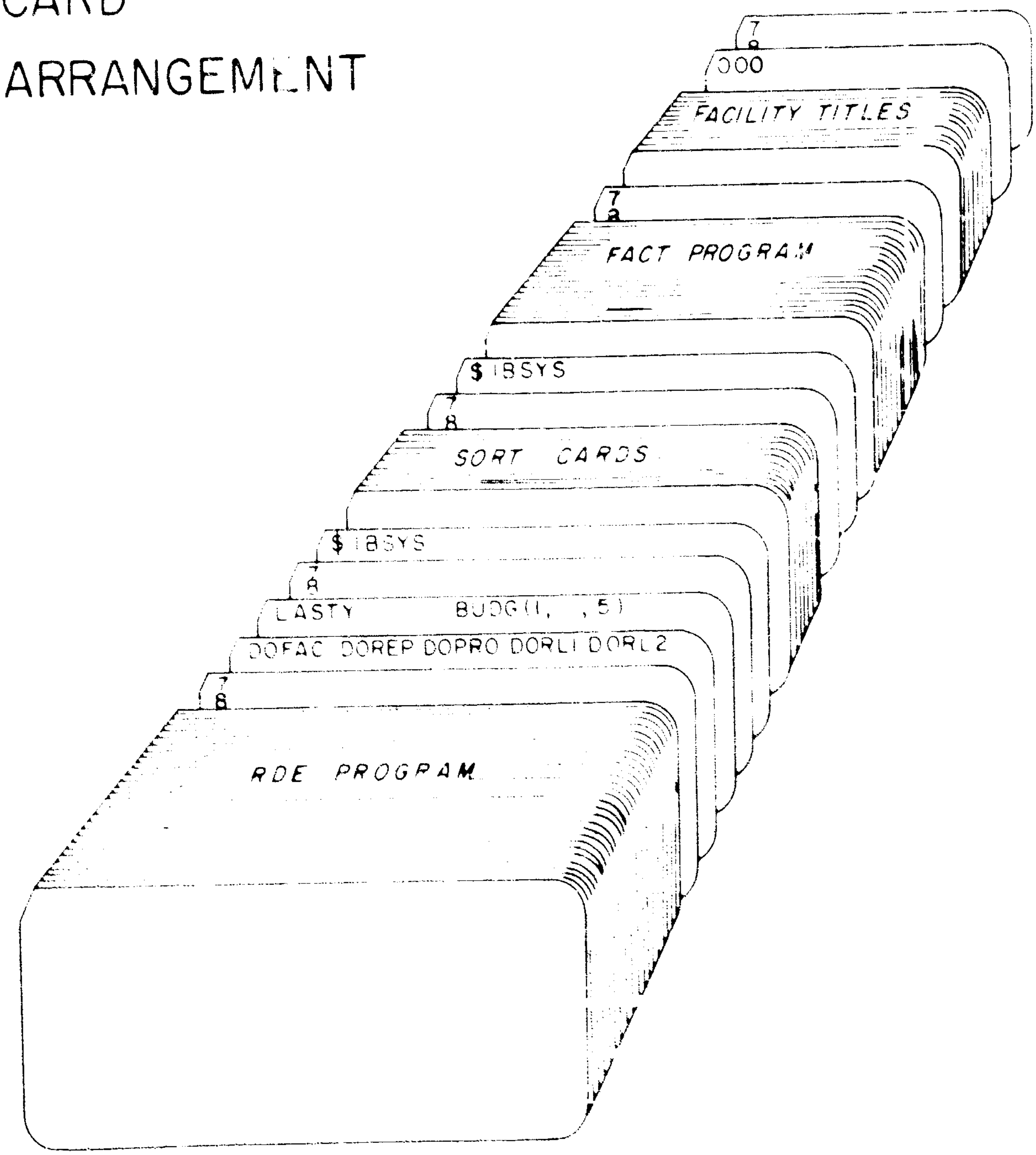

Figure 17. RDE68 Deck Setup

5. In many cases small numbers are added to computed quantities. This is to circumvent certain round off problems which developed during the debug phases of the program, and have nothing to do with the formulation.

6. Once the input data tape has been generated by EDIT, the rest of the programs run as a system. Between the final report routine and the facility listing program, there is a 7090 Sort, to arrange the facility data in its proper order. Subroutine FINAL writes a series of records for each task which uses facilities, each record pertaining to the utilization of a facility. The tasks being processed are in ascending order. The purpose of the 7090 Sort pass is to sort the records by facility, the tasks then being in ascending order by facility. It is this order the FACT routine requires to produce its report. As a matter of interest, the record to be sorted has the following construction:

WORD	DESCRIPTION
1	IOCS generated
2	Facility code
3	Task number
4 - 7	Task engineer's name
8	Task engineer's telephone extension
9 - 13	Facility utilization by year

7. The size of the dimensions of all variables both in COMMON and in DIMENSION are the same in all routines in which they appear.

8. The program is designed to run on a 7040/7090 Direct Coupled System, where 7090 has only core to core communication with the 7040. The 7040 in turn handles all the I/O equipment including tape and pseudo tape data areas in the 1301 disk file.

Minimal configuration for a stand-alone 7090 with no disk would be 4 tapes: 1 for input, 2 for scratch files (preferably on different channels), and 1 for output. This is excluding normal input and output units, and systems and library files. The sort configuration will be a function of the order of merge desired.

9. Running times are extremely variable when using the DCS, but a rough approximation will be given. The values are based on about 250 tasks being processed for 5 years.

	7090 Time	Lines Output
EDIT	1 MIN	4000
RDE	6 MIN	15000
SORT	1 MIN	300*
FACT	1 MIN	3500

* Number of records sorted

```
      EDIT.

C     RTN TO PRE-EDIT RCE INPUT DATA
C
      COMMON /ED/ ERROR,IC,ICT(2),ITASK
      DIMENSION CAS(8),CLH(4),CSH(4),CS(2),DUM(15),EC(2),EI(2),ENC(8),
     1          ENI(8),IAR(5),IFAC(6,8),IALF(5),IS(15),IT(15),ITITLE(8),
     2          LF(6,80),LIM(5),NAMP(4),NAMT(4),OCC(6,8),RWU(10),S(15),
     3          T(15),TS(15),TT(15)
      LOGICAL ERROR,HCP
      DATA NSY,NTG,HDR/14,116,T/
      DATA (IALF(I),I=1,5)/1H1,1H2,1H3,1H4,1H5/
      DATA (LF(1,I),I=1,80)/
     1              0100,0101,0200,0300,0400,0500,0501,0502,0503,0504,
     2              0600,0601,0602,0700,0701,0800,0900,0901,0902,0903,
     3              0904,59*0/
      DATA (LF(2,I),I=1,80)/
     1              1000,1100,1200,1300,1400,1401,1500,1600,1700,1800,
     2              1900,1901,1902,1903,1904,65*0/
      DATA (LF(3,I),I=1,80)/ 80*0/
      DATA (LF(4,I),I=1,80)/
     1                   3001,3002,3003,3004,3005,3006,3007,3008,3009,
     2                   3010,3011,3012,68*0/
      DATA (LF(5,I),I=1,80)/
     1              4001,4002,4003,4004,4005,4006,4007,4008,4009,4010,
     2              4011,4012,68*0/
      DATA (LF(6,I),I=1,80)/
     1              5010,5011,5012,5013,5020,5021,5022,5030,5040,5041,
     2              5050,5051,5052,5053,5054,5055,5056,5057,5058,5059,
     3   5060,5061,5062,5063 ,5090,5091,5092,5093,5100,5110,5111,5120,
     4         5130,5131,5132,5140,5141,5150,5160,5170,5180,5190,5200,
     5         5210,5211,5220,5230,5231,5232,5233,5234,5235,5236,5237,
     6         5238,5239,5240,5241,5242,5300,5301,5400,5401,17*0/
      DATA (IAR(I),I=1,5)/ 33,35,67,19,37/
C
C     BEGIN EDIT, BRING IN TASK COUNT
C
      READ (5,390) NT
      CALL DATE (ICT)
      IDP=0
      ERROR=.FALSE.
      IK=0
C
C     READ FIRST CC.
C
100   READ (5,390) ITASK,NAMT,IDIV,ISYM,LEXT,NAMP,LIM,AR,IC
      ITAT=ITASK
      IF (ITAT.LE.999999) ITAT=ITAT*100
      IF (ITASK.EQ.99999999) GO TO 280
      IK=IK+1
      IF (IDIV.NE.IDP) GO TO 110
C
C     CHECK FOR ASCENDING TASK SEQUENCE
C
      IF (ITAT.LT.ITP) CALL EWRT (14)
      GO TO 120
110   IDP=IDIV
```

```
                EDIT.
120     ITP=ITAT
        IF (IC.EQ.1) GO TO 130
        CALL EWRT (1)
        GO TO 100
C
C       CHANGE IDIV FROM ALFA TO INTEGER
C
130     DO 140 I=1,5
C
C       CHECK FOR PROPER DIV. NR
C
        IF (IDIV.EQ.IALF(I)) GO TO 150
140     CONTINUE
        CALL EWRT (2)
150     IDIV=I
C       CHECK FOR AR FACTOR IN RANGE
        IR=AR+.0001
        IF (IR.GT.IAR(IDIV)) CALL EWRT (3)
C
C       READ SECOND CD.
C
        READ (5,400) ITK,ITITLE,CS,CLH(1),CSH(1),IC
        IF (IC.NE.2) GO TO 100
        IF (ITK.NE.ITASK) CALL EWRT (4)
C
C       READ THIRD CD.
C
        READ (5,410) ITK,IT,EC,CLH(2),CSH(2),IC
        IF (IC.NE.3) GO TO 100
        IF (ITK.NE.ITASK) CALL EWRT (4)
C
C       READ FOURTH CD.
C
        READ (5,420) ITK,T,EI,CLH(3),CSH(3),IC
        IF (IC.NE.4) GO TO 100
C
C       CHECK RL1 TOTAL ENG GREATER THAN .3
C
        IF (EC(1)+EI(1).LT..29) CALL EWRT (15)
C
C       CHECK DOUBLE MANYEARS
C
        IF (2.*(EC(1)+EI(1))+.0001.LT.EC(2)+EI(2).OR.EC(1)+EI(1).GT.EC(2)+
       1EI(2)+.0001) CALL EWRT (5)
        IF (ITK.NE.ITASK) CALL EWRT (4)
C
C       READ FIFTH CD.
C
        READ (5,430) ITK,IS,CLH(4),CSH(4),IC
        IF (IC.NE.5) GO TO 100
        IF (ITK.NE.ITASK) CALL EWRT (4)
C
C       CHECK FIRST YR CONF LEVEL
C
        IF (CLH(4).GT..7999) CALL EWRT (6)
C
```

```
      EDIT.
C     READ SIXTH CC.
C
      READ (5,440) ITK,S,RWU,IC
      IF (IC.NE.6) GO TO 100
      IF (ITK.NE.ITASK) CALL EWRT (4)
C
C     CHECK SYSTEMS + TECH OBJ DATA
C
      DO 160 I=1,15
      IF (IT(I).GT.NTG) CALL EWRT (7)
      IF (T(I).GT.1.) CALL EWRT (7)
      IF (IS(I).GT.NSY) CALL EWRT (8)
      IF (S(I).GT.1.) CALL EWRT (8)
160   CONTINUE
C     WRITE OUT INPUT DATA + RPT FOR THIS TASK
      IF (.NOT.HDR) GO TO 170
      WRITE (8,290) IDT
      HDR=.NOT.HDR
170   WRITE (8,300) IDIV,ITAT,ITITLE,IR,LIM
      WRITE (8,310)
      ITC=0
      ISC=0
      DO 180 N=1,15
      TS(N)=FLOAT(IS(N))*.01
180   TT(N)=FLOAT(IT(N))*.001
      WRITE (8,320) TT,TS
      WRITE (8,330) T,S
      WRITE (8,340)
      WRITE (8,350) (CLH(N),N=1,4),CS(1),EC(1),EI(1),RWU
      WRITE (8,360) (CSH(N),N=1,4),CS(2),EC(2),EI(2)
      WRITE (8,370)
C     READ CONF LEVEL DATA
      DO 190 I=1,6
      DO 190 J=1,8
190   IFAC(I,J)=0
      CLB=FLOAT(IFIX(10.001*CLH(4)))/10.
200   READ (5,450) ITK,CL,DUM,IC
C
C     CHECK CL INCREASING BY .1
C
      IF (ABS(CLB+.1-CL).LT..0001) GO TO 210
      CALL EWRT (9)
      GO TO 100
210   ICL=CL*10.+.0001
      CAS(ICL)=DUM(1)
      ENC(ICL)=DUM(2)
      ENI(ICL)=DUM(3)
      NV=0
      DO 250 I=1,6
      IF ((DUM(2*I+2).EQ.0.).AND.(DUM(2*I+3).EQ.0.)) GO TO 260
      NV=I
      IL=DUM(2*I+2)*.001+1.0001
      IF (IL.GT.6) GO TO 230
C
C     CHECK FOR VALID FACILITY CODE
C
```

```
     EDIT.
      IFAC(I,ICL)=DUM(2*I+2)+.0001
      DO 220 K=1,80
      IF (IFAC(I,ICL).EQ.LF(IL,K)) GO TO 240
220   CONTINUE
230   CALL EWRT (10)
C
C     CHECK FOR NON ZERO OCC HRS ON FAC CODES
C
240   OCC(I,ICL)=DUM(2*I+3)
      IF ((IFAC(I,ICL).NE.0).AND.(OCC(I,ICL).EQ.0.)) CALL EWRT (11)
      IF ((OCC(I,ICL).NE.0.).AND.(IFAC(I,ICL).EQ.0)) CALL EWRT (12)
250   CONTINUE
260   IF (NV.LE.0) WRITE (8,380) ICL,CAS(ICL),ENC(ICL),ENI(ICL)
      IF (NV.GT.0) WRITE (8,380) ICL,CAS(ICL),ENC(ICL),ENI(ICL),(IFAC(NR
     1,ICL),OCC(NR,ICL),NR=1,NV)
C     ADJUST INITIAL RESOURCES IF FIRST YR IS NOT EVEN TENTH
      IF (CLH(4)-CLB.LT..001.OR.IC.GT.7) GO TO 270
      DEN=(CLB+.1-CLH(4))*10.
      CAS(ICL)=CAS(ICL)/DEN-.001
      ENC(ICL)=ENC(ICL)/DEN-.001
      ENI(ICL)=ENI(ICL)/DEN-.001
270   CLB=CL
      IF (ICL.LT.8) GO TO 200
C     WRITE INPUT DATA FOR THIS TASK ON MASTER FILE
      ITAT=ITAT+IDIV*100000000
      IF (.NOT.ERROR) WRITE (1) ITAT,NAMT,ISYM,LEXT,NAMP,LIM,IR,ITITLE,C
     1S,EC,EI,CLH,CSH,IT,T,IS,S,RWU,CAS,ENC,ENI,IFAC,OCC
      GO TO 100
280   IF (IK.NE.NT) CALL EWRT (13)
      IF (.NOT.ERROR) WRITE (6,460)
C
C     WRITE TRLR
C
      WRITE (1) (ITASK,I=1,240)
      END FILE 1
      REWIND 1
      STOP
C
290   FORMAT (1H15X26HRDE   FY   1969   INPUT   DATA39X2A6)
300   FORMAT (1H2/10HODIVISION I2,7X4HTASKI10,4X5HTITLE4X8A6,4X2HARI3,7X
     118HLIMITED   WAR   DATA/110X2HLW2X2HSW2X2HIN2X2HCS2X2HLG/110X5(A2,2X
     2))
310   FORMAT (20X23HSUPPORT   OF   TECH   OBJS42X20HSUPPORT   OF   SYSTEMS)
320   FORMAT (5H TO   15(1XF3.3),5X4HSYS 15(1XF2.2))
330   FORMAT (5H SUP 15(3H   .F1.1),5X4HSUP 15(2H .F1.1)///)
340   FORMAT (15X7HHISTORY21X18HFY - 69   RESOURCES/8X2H655X2H665X2H675X2
     1H6817X2HCS4X4HENGC3X5HENGIH20X22HASSOCIATED   1498   WORK,6H UNITS)
350   FORMAT (3H CL4F7.2,8X3HRL13F8.1,15X10A5)
360   FORMAT (3H CS4F7.1,8X3HRL23F8.1//)
370   FORMAT (23HC   CL VS. RESOURCE DATA35X21HFACILITY   UTILIZATION/3H C
     1L5X2HCS3X4HENGC2X5HENGIH5X6(17HFACILITY   OCC   )/27X6(17H   CODE
     2   HOURS))
380   FORMAT (2H .I1,3F7.1,2X6(I5,F8.0))
390   FORMAT (I8,3A6,A3,A1,2A5,4A6,5A2,F3.0,I3)
400   FORMAT (I8,7A6,A4,5X,2F4.0,2X2F4.0,I3)
410   FORMAT (I8,1X15I3,5X,2F4.0,2X2F4.0,I3)
```

```
      EDIT.
420   FORMAT (I8,1X15F3.0,5X,2F4.0,2X2F4.0,I3)
430   FORMAT (I8,1X15I2.30X2F4.0,I3)
440   FORMAT (I8,1X15F2.0,10A3,8XI3)
450   FORMAT (I8,F3.1,3F5.0,12F4.0,3XI3)
460   FORMAT (16H1NO INPUT ERRORS//4H0EOJ)
      END
```

EWRT.

```
      SUBROUTINE EWRT (I)
C
C     RTN TO WRITE ERROR MSGS FOR EDIT PGM.
C
      COMMON /EC/ ERROR,IC,IDT(2),ITASK
      LOGICAL ERROR
      IF (I.EQ.1) WRITE (6,100) ITASK,IC
      IF (I.EQ.2) WRITE (6,110) ITASK
      IF (I.EQ.3) WRITE (6,120) ITASK
      IF (I.EQ.4) WRITE (6,130) ITASK,IC
      IF (I.EQ.5) WRITE (6,140) ITASK
      IF (I.EQ.6) WRITE (6,150) ITASK
      IF (I.EC.7) WRITE (6,160) ITASK
      IF (I.EQ.8) WRITE (6,170) ITASK
      IF (I.EQ.9) WRITE (6,180) ITASK,IC
      IF (I.EQ.10) WRITE (6,190) ITASK,IC
      IF (I.EQ.11) WRITE (6,200) ITASK,IC
      IF (I.EQ.12) WRITE (6,210) ITASK,IC
      IF (I.EQ.13) WRITE (6,220) ITASK,IC
      IF (I.EQ.14) WRITE (6,230) ITASK
      IF (I.EQ.15) WRITE (6,240) ITASK
      ERROR=.TRUE.
      RETURN
C
100   FORMAT (1HC2I10,2X20HCARD OUT OF SEQUENCE)
110   FORMAT (1HOI10,2X21HINVALID DIVISION CODE)
120   FORMAT (1HOI10,2X19HAR FACTOR TOO LARGE)
130   FORMAT (1H02I10,2X45HPROJ, TASK, OR SUBTASK DISAGREES WITH 01 CARD
     1)
140   FORMAT (1HCI10,2X29HERROR IN DOUBLE ENGINEER DATA)
150   FORMAT (1HOI10,2X20HCL68 GREATER THAN .9)
160   FORMAT (1HOI10,2X22HERROR IN TECH OBJ DATA)
170   FORMAT (1HCI10,2X28HERROR IN SYSTEM SUPPORT DATA)
180   FORMAT (1H02I10,2X31HCONF LEVEL DATA OUT OF SEQUENCE)
190   FORMAT (1HC2I10,2X21HILLEGAL FACILITY CODE)
200   FORMAT (1HC2I10,2X21HNO HOURS FOR FAC CODE)
210   FORMAT (1HC2I10,2X21HNO FAC CODE FOR HOURS)
220   FORMAT (1H02I10,2X19HTASK COUNT IN ERROR)
230   FORMAT (1HOI10,2X20HTASK OUT OF SEQUENCE)
240   FORMAT (1HOI10,2X36HTOTAL ENGINEERS LESS THAN .3 FOR RL1)
      END
```

```
M4

     $IBLDR M4                  22 APR 68                                          M4000000

     $FILE  M4        'UNIT01',K(1),READY,INOUT,BIN,BLK=256                        M4000001

     $FILE  M4        'UNIT08',A(1),READY,INOUT,BCD,BLK=22                         M4000002




              ERROR

                  $TEXT  ERROR

                                       ENTRY    .OPTW.                          D   2

BINARY CARD ID. ERROR002
       00000  000000000014      10000  .OPTW. OCT      000000000014 OPTION 32 AND 33 D   3
       00001  000000000000      10000         DEC      0                             D   4
       00002  000000000000      10000         DEC      0                             D   5
                          00000  01111         END                                   D   6-
```

```
      EXEC.

C     EXEC RTN TO DRIVE THE RDE PROGRAM
C
      LOGICAL DOFAC,DOREP,DOPRO,DORL1,DORL2
      COMMON /EX/ BUDG(5),DOFAC,DOREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CEN
     1G,LASTY
C
C     USE OF THE LOGICAL VARIABLES - WHEN SET TRUE --
C
C     DOFAC - PRODUCE FACILITY LISTING TAPE AS INPUT TO SORT
C     DOREP - PRODUCE BJ,BJ',TECH OBJ MATRICIES AND LIMWAR AND
C                     WORK UNIT LISTINGS
C     DORL1 - PRODUCE OPTIMAL ALLOCATION USING ONLY RESOURCE LEVEL 1
C     DORL2 - PRODUCE OPTIMAL ALLOCATION USING ONLY RESOURCE LEVEL 2
C     DOPRO - PRODUCE SYSTEM AND TECH. OBJ. PROFILES
C
C     TAPE UTILIZATION --
C
C     LOGICAL                                                    USED
C      UNIT                                                       IN
C
C       1        INPUT MASTER FILE                      EXEC,INIT,FNAL
C       7        WORK TAPE                              EXEC,INIT,BJP
C       3        PRINT FILE FOR B(J)' REPORTS                 BJP
C      11        FACILITY DATA INPUT TO SORT        EXEC,BJP ,SMLP,FNAL
C
      CALL DATE (IDT)
      REWIND 1
      READ (5,110) DOFAC,DOREP,DOPRO,DORL1,DORL2
      READ (5,120) LASTY,BUDG
      IF (LASTY.GT.5) LASTY=5
      WRITE (6,140) (I,BUDG(I),I=1,LASTY)
      CALL INIT
      REWIND 1
      REWIND 7
      CALL BJP
      IF (LASTY.LE.0) STOP
      REWIND 7
      DO 100 IY=1,LASTY
      REWIND 11
100   CALL SMLP
      REWIND 1
      REWIND 11
      IF (LASTY.GT.1) CALL FINAL
      REWIND 11
      WRITE (6,130)
      STOP
C
110   FORMAT (5L5)
120   FORMAT (I5,5E10.0)
130   FORMAT (4H1EOJ)
140   FORMAT (5(1X6HYEAR =I2,4X8HBUDGET =F7.0/))
      END
```

DATA.

```
      BLOCK DATA
      COMMON /EX/ BUDG(5),DOFAC,DOREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CEN
     1G,LASTY
      COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),
     1              CSUM(6),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),
     2              LIM(5),NPH(14,28),RWU(10),S(15),T(15),
     3              TG(117)
      COMMON /FIVE/ CLY(250,6),ITP(250),LR(250,5),PER(250),
     1              TBJ(16),TGK(117)
      DATA CENG/12.7/
C
C     TBJ=TIME FOR SYSTEM COMPLETION
C
      DATA (TBJ(I),I=1,16)/2*2.,3.,5*2.,4.,2*2.,4.,3.,4.,2*0./
C
C     TGK=TIME FOR TECH OBJ COMPLETION
C
      DATA (TGK(I),I=1,117)/2.,9.,2.,5.,2.,2.,6.,2.,3.,3.,3*2.,3.,
     1                      3*2.,11.,3.,4.,2.,2.,6*3.,3*2.,6.,6.,2.,
     2                      9.,6.,7.,6.,7.,6.,2.,3.,2.,3.,3.,6.,2.,
     3                      5.,3.,3.,2.,3.,2.,6.,2.,3.,8.,2.,6.,3*3.,
     4                      2.,6.,3*2.,6.,5.,4.,4.,3.,
     5                      4.,3.,2*2.,6.,2.,6.,2.,4.,7*2.,3.,4.,6.,
     6                      2.,4.,2.,2*4.,2.,3.,4.,6.,4.,4*2.,2*3.,
     7                      2.,6.,2.,2.,3.,2.,2.,3.,2.,0./
      DATA (NPH(1,K),K=1,12)/
     1 60HSTRUCTURAL TESTING OF FLIGHT VEHICLES                         ,
     2 60HSTRUCTURAL DESIGN CRITERIA                                    ,
     3 60HSTRUCTURAL DESIGN CONCEPTS                                    ,
     4 60HSTRUCTURAL ANALYSIS METHODS                                   ,
     5 60HAERODYNAMICS AND FLIGHT MECHANICS                             ,
     6 60HEXPERIMENTAL SIMULATION OF FLIGHT MECHANICS                   ,
     7 60HFLIGHT PATH ANALYSIS                                          ,
     8 60HAIRFRAME - EXHAUST NOZZLE INTEGRATION                         ,
     9 60HCONTROL DISPLAY                                               ,
     A 60HSTABILITY AND CONTROL INVESTIGATIONS                          ,
     B 60HCONTROL DATA SYSTEM AND INSTR. TECHNOLOGY FOR ADV. VEHICLES   ,
     C 60HSTORED ENERGY DATA SYS + INSTR. FOR AEROSPACE VEHICLES        /
      DATA (NPH(1,K),K=13,26)/
     1 60HFLIGHT CONTROL EQUIPMENT TECHNIQUES                           ,
     2 60HFLIGHT CTL SYS TECH FOR STABILIZATION + CTL OF ADV VEHICLES   ,
     3 60HDYNAMIC PROBLEMS IN FLIGHT VEHICLES                           ,
     4 60HAERO - ACOUSTIC PROBLEMS                                      ,
     5 60HDYNAMIC MEASUREMENT AND ANALYSIS TECHNOLOGY                   ,
     6 60HHIGH INTENSITY SOUND ENVIRONMENT SIMULATION                   ,
     7 60HENVIRONMENTAL INTERACTIONS                                    ,
     8 60HBEARINGS AND SPECIAL COMPONENTS                               ,
     9 60HCREW ESCAPE FOR FLIGHT VEHICLES                               ,
     A 60HMECHANICAL SUBSYSTEMS FOR ADVANCED FLIGHT VEHICLES            ,
     B 60HCREW STATION RESEARCH FOR AEROSPACE VEHICLES                  ,
     C 60HCRYOGENIC COOLING TECHNOLOGY                                  ,
     D 60HPERFORMANCE + DESIGN OF DEPLOYABLE AERODYNAMIC DECELERATORS   ,
     E 60HENVIRONMENTAL CONTROL                                         /
      END
```

INIT.

```
      SUBROUTINE INIT
C
C     RTN TO PRODUCE INITIAL RPTS + DATA NEC. FOR FURTHER COMP.
C
      DIMENSION CE(16),COLS(16),CAS(8),ENC(8),ENI(8),NAMP(4),NAMT(4)
      LOGICAL DOFAC,DOREP,DOPRO,DORL1,DORL2
      COMMON /EX/ BUDG(5),DOFAC,DOREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CEN
     1G,LASTY
      COMMON /BJTG/ CAVG(16)
      COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),
     1              CSUM(8),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),
     2              LIM(5),NPH(14,28),RWU(10),S(15),T(15),
     3              TG(117)
      DATA (CE(I),COLS(I),I=1,16)/32*0./,IPT,IPC/2*0/,II/1H /
      IF (DOREP) WRITE (8,230) IDT
      IF (DOREP) WRITE (6,220) IDT,(K,K=1,16)
      NT=0
C
C     READ IN DATA BY TASK
C
100   READ (1) ITASK,NAMT,ISYM,LEXT,NAMP,LIM,IR,(ITITLE(J,NT+1),J=1,8),C
     1S,EC,EI,CLH,CSH,IT,T,IS,S,RWU,CAS,ENC,ENI
C
      IF (ITASK.EQ.99999999) GO TO 190
      NT=NT+1
C
C     WRITE LIMWAR DATA
C
      DO 110 J=1,5
      IF (LIM(J).EQ.II) GO TO 110
      IF (DOREP) WRITE (8,240) ITASK,LIM
      GO TO 120
110   CONTINUE
120   IF (ITASK/10000.EQ.IPT) GO TO 140
      IPC=IPC+1
C
C     CHECK THAT NUMBER OF PROJECTS LESS THAN 28
C
      IF (IPC.GT.28) GO TO 210
      IPT=ITASK/10000
      DO 130 K=11,14
C
C     BUILD ARRAY OF PROJ ENGINEERS
C
130   NPH(K,IPC)=NAMP(K-10)
C
C     DEVELOP BJ ROW AND COL. SUMS
C
140   RE=0.
      RSUM=0.
C
C     ZERO BJ ARRAY
C
      DO 150 I=1,16
150   BJ(I)=0.
```

INIT.

```
      DO 160 I=1,15
      IF (IS(I).EQ.0) GO TO 160
      IB=IS(I)
      BJ(IB)=S(I)
      RSUM=RSUM+S(I)
      RE=RE+1.
      COLS(IB)=COLS(IB)+BJ(IB)
      CE(IB)=CE(IB)+1.
160   CONTINUE
      RAVG=RSUM/RE
C
C     WRITE BJ DATA
C
      IF (DOREP) WRITE (6,250) ITASK,BJ,RAVG
C
C     CONVERT ENGINEERS TO EQUIVALENT $
C
      DO 170 K=1,2
170   COST(K)=CS(K)+CENG*(EC(K)+EI(K))
      DO 180 K=1,8
180   CSUM(K)=CAS(K)+CENG*(ENC(K)+ENI(K))
C
C     WRITE TASK RECORD
C
      WRITE (7) ITASK,IR,CLH(4),CS,EC,EI,COST,CSUM,BJ,IT,T,RWU
      GO TO 100
C
C     END READ LOOP
C
C     WRITE COL. SUMS
C
190   IF (DOREP) WRITE (6,260) COLS
C
C     COMP AND WRITE COL. AVGS
C
      DO 200 I=1,16
200   CAVG(I)=COLS(I)/CE(I)
      IF (DOREP) WRITE (6,270) CAVG
      RETURN
210   WRITE (6,280)
      STOP
C
220   FORMAT (1H148X15HROE 1969     BJ5X,21H VERSUS SYSTEM MATRIX33X2A6/
     1/65X7HSYSTEMS53X7HAVERAGE/3X4HTASK4X16I7,3X6HACROSS//)
230   FORMAT (1H16X4HTASK9X11HLIMITED WAR9X11HSPECIAL AIR9X12HINTERDICTI
     1ON7X5HCLOSE14X9HLOGISTICS15X2A6/42X7HWARFARE30X7HSUPPORT//)
240   FORMAT (5XI8,11XA2,18XA2,19XA2,15XA2,20XA2)
250   FORMAT (1XI8,3X16(5X1H.F1.1),3XF6.4)
260   FORMAT (1X131(1H-)/6H TOTAL7X16F7.2)
270   FORMAT (1X131(1H-)/9H VERT AVG4X16F7.2)
280   FORMAT (19H1NR PROJ EXCEEDS 28)
      END
```

BJP.

```
      SUBROUTINE BJP
C
C     RTN TO COMP. BJ' VALUES
C
      LOGICAL DOFAC,DOREP,DOPRO,DORL1,DORL2
      COMMON /EX/ BUDG(5),DOFAC,DOREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CEN
     1G,LASTY
      COMMON /BJTG/ CAVG(16)
      COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),
     1              CSUM(3),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),
     2              LIM(5),NPH(14,28),RWU(10),S(15),T(15),
     3              TG(117)
      DIMENSION DMY(17),CJ(16),HK(117)
C
C     CJ=SYSTEM WEIGHTS
C
      DATA (CJ(J),J=1,16)/.137,.015,.107,.122,.152,.073,.091,.076,
     1                    .070,.001,.043,.030,.046,.037,2*0./
C
C     HK=TECH OBJ WEIGHTS
C
      DATA (HK(J),J=1,117)/.118,.049,.049,.015,.118,.152,.015,.083,
     1                    .083,.049,.152,.083,.152,.083,.083,.049,
     2                    .015,.118,2*.083,.118,.083,.049,.083,
     3                    3*.049,.015,2*.152,.015,.083,.049,.083,
     4                    2*.049,.015,.049,2*.015,2*.118,.083,.049,
     5                    .083,2*.152,.049,.083,.049,3*.015,.118,
     6                    .015,.083,2*.118,.152,3*.049,.015,2*.083,
     7                    2*.015,.083,.049,3*.015,
     8                    .049,.015,.015,.049,2*.015,.049,2*.015,
     9                    2*.118,.083,2*.015,.083,.049,.015,.083,
     A                    .049,3*.118,.083,.049,.083,.049,.049,
     B                    .083,.015,.049,2*.083,.118,.015,.049,
     C                    2*.083,2*.049,.083,.049,.083,.118,.083,
     D                    0./
      IF (DOREP) WRITE (6,280)
      IF (DOREP) WRITE (8,210) IDT,(K,K=1,61)
      DO 120 I=1,NT
C
C     READ A TASK
C
      READ (7) ITASK,IR,DMY,BJ,IT,T,RWU
      IF (DOREP) WRITE (6,270) ITASK,RWU
      DO 100 J=1,117
100   TG(J)=0.
      DO 110 J=1,15
      IF (IT(J).LT.1) GO TO 110
      IG=IT(J)
      TG(IG)=T(J)
110   CONTINUE
120   IF (DOREP) WRITE (8,220) ITASK,(TG(J),J=1,61)
      IF (DOREP) WRITE (6,230) IDT,(K,K=1,16)
      IF (DOREP) WRITE (8,240) IDT,(K,K=62,117)
C
C     REWIND DATA TAPE FOR SECOND PASS
```

```
      BJP.
C
      REWIND 7
      DO 200 I=1,NT
      READ (7) ITASK,IR,DMY,BJ,IT,T
C
C     CALC BJ'
C
      DO 130 J=1,16
130   BP(J)=0.
      RSUM=0.
      RE=0.
      DO 140 J=1,16
      IF (BJ(J).LT..0001) GO TO 140
      BP(J)=BJ(J)
      IF (BP(J).GT.CAVG(J)) BP(J)=BJ(J)*(1.+2.5*(BJ(J)-CAVG(J)))
      RSUM=RSUM+BP(J)
      RE=RE+1.
140   CONTINUE
      RAVG=RSUM/RE
      IF (DOREP) WRITE (6,260) ITASK,BP,RAVG
C
C     DEVELOP BP*CJ TERM OF OBJECTIVE FUNCTION
C
      DO 150 J=1,16
150   BP(J)=BP(J)*CJ(J)
      DO 160 J=1,117
160   TG(J)=0.
      RSUM=0.
      RE=0.
      DO 180 J=1,15
      IF (IT(J).LT.1) GO TO 170
      IG=IT(J)
      TG(IG)=T(J)
170   RSUM=RSUM+TG(IG)
      RE=RE+1.
180   CONTINUE
      RAVG=RSUM/RE
      IF (DOREP) WRITE (8,250) (TG(J),J=62,117),RAVG,ITASK
C
C     DEVELOP TG*HK TERM OF OBJECTIVE FUNCTION
C
      DO 190 J=1,117
190   TG(J)=TG(J)*HK(J)
200   WRITE (11) ITASK,IR,DMY,BP,TG
      RETURN
C
210    FORMAT (1H145X47HRDE 1969     GK VERSUS TECHNOLOGICAL OBJS MATRIX,5
     1H PT1 22X2A6//63X10HTECH OBJS //2X4HTASK22X10(2H1 ),10(2H2 ),10(2H
     23 ),10(2H4 ),10(2H5 ),3H6 6/9X61(1XI1))
220    FORMAT (1XI8,1X61F2.1)
230    FORMAT (1H148X21HRDE 1969      BJ PRIME9X20HVERSUS SYSTEM MATRIX,24
     1X2A6//65X7HSYSTEMS53X7HAVERAGE/3X4HTASK,4X16I7,3X6HACROSS//)
240    FORMAT (1H145X47HRDE 1969     GK VERSUS TECHNOLOGICAL OBJS MATRIX,5
     1H PT2 22X2A6//63X10HTECH OBJS /2X,76X18(2H1 )/2X8(2H6 ),10(2H7 ),1
     20(2H8 ),10(2H9 ),10(2H0 ),8(2H1 )/1X56(1XI1),2X7HAVERAGE3X4HTASK)
250    FORMAT (2X56F2.1,F7.3,3XI8)
```

```
      BJP.
260   FORMAT (2XI3,15F7.1,3XF6.4)
270   FORMAT (1XI3,6X10A6)
280   FORMAT (1H13X4HTASK20X29HASSOCIATED  1498  WORK  UNITS//)
      END
```

SMLP.

```
      SUBROUTINE SMLP
C
C     RTN TO SIMULATE LINEAR PGM AND DEVELOP TASK RANK BY RDE
C
      COMMON /EX/ BUDG(5),DOFAC,DOREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CON
     1G,LASTY
      COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),
     1              CSUM(8),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),
     2              LIM(5),NPH(14,28),RWU(10),S(15),T(15),
     3              TG(117)
      COMMON /FIVE/ CLY(250,6),ITP(250),LR(250,5),PER(250),
     1              TBJ(16),TGK(117)
      DIMENSION ALAB(4),CL(2),CLP(250),CSP(250),DN(5),DT(4),
     1              ECP(250),EIP(250),IPRL(250),IRANK(250),LRP(250),
     2              NOH(3,5),OBJ(2),OBJP(250),PART(5),PRL(250),
     3              PT(4),RATIO(250),T8(2)
      DATA (DN(I),I=1,5)/ 30.,35.,67.,19.,37./
      LOGICAL DOFAC,DOREP,DOPRO,DORL1,DORL2
      LOGICAL WRITEL
      DATA   (NOH(1,I),I=1,5)       /18HSTRUCTURES        ,
     1                               18HFLIGHT MECHANICS  ,
     2                               18HFLIGHT CONTROL    ,
     3                               18HVEHICLE DYNAMICS  ,
     4                               18HVEHICLE EQUIPMENT /
      DATA IBLNK,ISNO/1H ,6HNONSEL/,MPR,MDV,MLB/4HPROJ,3HDIV,3HLAB/
      IYBAR=IY+1968
      YEAR=IY-1
      DO 180 I=1,NT
      READ (11) ITP(I),IR,CLY(I,1),CS,EC,EI,COST,CSUM,BP,TG
      ID=ITP(I)/100000000
C
C     GENERATE WEIGHTING FACTOR FROM TASK RANK IN DIV
C
      X=FLOAT(IR-1)/(DN(ID)-1.)
      AR=EXP(-X**2)+.37
C
C     CALC COST AND OBJ COEF FOR EA RESOURCE LEVEL
C
      DO 170 K=1,2
      PART(K)=1.
      COST(K)=COST(K)+.001
      CLB=CLY(I,IY)
C
C     FIND T8 .LE. 12 YEARS
C
      T8(K)=0.
100   CLA=CLNU(CLB,COST(K))
      IF (T8(K).LT..1) CL(K)=CLA
      T8(K)=T8(K)+1.
      IF (CLA.GE..8) GO TO 110
      CLB=CLA
      IF (T8(K).LT.12.) GO TO 100
110   IF (ABS(CL(K)-.8).GT..0001) GO TO 140
      CB=0.
C
```

SMLP.

```
C     CALC $ TO REACH .8 IF REACHED THIS YEAR
C
      DO 120 J=2,7
      JJ=9-J
      IF (CLY(I,IY).GT..1*FLOAT(JJ)) GO TO 130
120   C8=C8+CSUM(JJ+1)
130   C8=C8+10.*(.1*FLOAT(JJ+1)-CLY(I,IY))*CSUM(JJ+1)
      PART(K)=C8/COST(K)
      CS(K)=CS(K)*PART(K)
      EC(K)=EC(K)*PART(K)
      EI(K)=EI(K)*PART(K)
      COST(K)=C8
140   BPSUM=0.
      DO 150 J=1,16
      DEN=TBJ(J)-YEAR
      BPJ=0.
      IF (DEN.GT..01) BPJ=BP(J)*TIM(T8(K)/DEN)
150   BPSUM=BPSUM+BPJ
      TGSUM=0.
      DO 160 J=1,117
      DEN=TGK(J)-YEAR
      TGJ=0.
      IF (DEN.GT..01) TGJ=TG(J)*TIM(T8(K)/DEN)
160   TGSUM=TGSUM+TGJ
170   OBJ(K)=((CL(K)-CLY(I,IY))/CLY(I,IY))*(BPSUM*AR+TGSUM)
      KP=1
      IF (OBJ(2)/COST(2).GT.OBJ(1)/COST(1)) KP=2
      IF (DORL1) KP=1
      IF (DORL2) KP=2
      CLP(I)=CL(KP)
      LRP(I)=KP
      CSP(I)=CS(KP)
      ECP(I)=EC(KP)
      EIP(I)=EI(KP)
      OBJP(I)=OBJ(KP)
      IF (CLY(I,IY).LT..799) PER(I)=PART(KP)
180   RATIO(I)=OBJP(I)/COST(KP)
      CALL SORT (RATIO,PRL,IPRL,NT,.TRUE.)
C
C     WRITE PRIORITY LIST
C
      WRITE (6,340) IYEAR,IOT
      WRITEL=.TRUE.
      SMCS=0.
      SMOB=0.
      SMCST=0.
      DO 220 I=1,NT
      IP=IPRL(I)
      IRANK(IP)=I
      SMCST=SMCST+CSP(IP)+CENG*(ECP(IP)+EIP(IP))
      SMCS=SMCS+CSP(IP)
      SMOB=SMOB+OBJP(IP)
      IF (SMCS.LE.BUDG(IY)) GO TO 200
      IF (.NOT.WRITEL) GO TO 190
      WRITE (6,330)
      WRITEL=.FALSE.
```

SMLP.

```
190   CLY(IP,IY+1)=CLY(IP,IY)
      LR(IP,IY+1)=0
      GO TO 210
200   CLY(IP,IY+1)=CLP(IP)
210   LR(IP,IY)=LRP(IP)
220   WRITE (6,360) I,ITP(IP),(ITITLE(J,IP),J=1,8),LRP(IP),CSP(IP),ECP(I
     1P),EIP(IP),OBJP(IP),RATIO(IP),SMCS,SMOB,SMCST
C
C     WRITE ANNUAL OUTPUT
C
      DO 230 K=1,4
      PT(K)=0.
      DT(K)=0.
230   ALAB(K)=0.
      IDP=ITP(1)/100000000
      IPP=ITP(1)/10000
      IPN=1
      DO 290 I=1,NT
      ID=ITP(I)/100000000
      IPROJ=ITP(I)/10000
      IF (I.EQ.1) GO TO 260
      IF (IPROJ.EQ.IPP) GO TO 280
      WRITE (6,320) MPR,PT
      DO 240 K=1,4
      DT(K)=DT(K)+PT(K)
240   PT(K)=0.
      IPP=IPROJ
      IPN=IPN+1
      IF (ID.EQ.IDP) GO TO 270
      WRITE (6,320) MDV,DT
      DO 250 K=1,4
      ALAB(K)=ALAB(K)+DT(K)
250   DT(K)=0.
260   IDP=ID
C
C     WRITE ANNUAL OUTPUT HDG
C
      NY=67+IY
      NYP1=NY+1
270   WRITE (6,350) (NDH(J,ID),J=1,3),IYEAR,IDT,IPROJ,(NPH(J,IPN),J=1,14
     1),NY,NYP1
280   ITASK=(ITP(I)-IPROJ*10000)+10000
      ISEL=ISNO
      IF (ABS(CLY(I,IY+1)-CLY(I,IY)).LT..001) GO TO 290
      ISEL=IBLNK
      PT(1)=PT(1)+OBJP(I)
      PT(2)=PT(2)+CSP(I)
      PT(3)=PT(3)+ECP(I)
      PT(4)=PT(4)+EIP(I)
      NRL=1
      IF (CLY(I,IY+1).LT.0.) NRL=2
290   WRITE (6,310) ISEL,ITASK,(ITITLE(J,I),J=1,4),CLY(I,IY),CLY(I,IY+1)
     1,OBJP(I),CSP(I),ECP(I),EIP(I),LRP(I),IRANK(I),(ITITLE(J,I),J=5,8)
      DO 300 K=1,4
      DT(K)=DT(K)+PT(K)
300   ALAB(K)=ALAB(K)+DT(K)
```

SMLP.

```
      WRITE (6,320) MPR,PT
      WRITE (6,320) MDV,DT
      WRITE (6,320) MLB,ALAB
      RETURN
C
310   FORMAT (2XA6,5XI4,6X4A6,2(7XF3.2),F11.4,3F10.2,I6,I13/23X4A6)
320   FORMAT (70X40(1H-)/53XA4,5X5HTOTALF11.4,3F10.2)
330   FORMAT (1H0132(1H*)//)
340   FORMAT (1H156X19HPRIORITY  LIST  FORI6,41X2A6/1C5X3(6X3HCUM)/13H R
     1ANK     TASK20X5HTITLE26X2HRL4X3HC+S4X4HENGC3X5HENGIH3X3HOBJ5X5HRAT
     2I06X3HC+S6X3HOBJ5X4HCUST//)
350   FORMAT (1H13A6,8HDIVISION24X16HANNUAL  OUTPUT  I6,47X2A6//9X7HPROJ
     1ECT1XI4,7X14A6/112X6H BEST 4X7HOVERALL/8H        5X4HTASK13X5HTITL
     2E18X2HCLI3,5X2HCLI3,5X3HOBJ7X3HC+S6X4HENGC6X5HENGIH6X2HRL9X4HRANK/
     3/)
360   FORMAT (I4,2XI8,2X7A6,A4,I4,F8.1,2(4XF3.1),F8.3,3XF6.5,F9.1,F9.3,F
     19.1)
      END
```

CLNU.

```
      FUNCTION CLNU (CLIN,CST)
C
C     RTN TO UPDATE CONF LEVEL
C
      COMMON /TASK/ BJ(16),BP(16),CLM(4),COST(2),CSH(4),CS(2),
     1              CSUM(8),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),
     2              LIM(5),NPH(14,28),RWU(10),S(15),T(15),
     3              TG(117)
      ICL=10.*CLIN+.0001
      IF (ICL.GE.8) GO TO 120
      CLNU=.1*FLOAT(ICL)+.00000001
      DCL=(CLIN-CLNU)*10.
      DCS=(1.-DCL)*CSUM(ICL+1)-.001
      IF (CST.GT.DCS) GO TO 100
      CLNU=CLIN+.1*CST/CSUM(ICL+1)
      GO TO 110
100   ICL=ICL+1
      IF (ICL.GE.8) GO TO 120
      CLNU=CLNU+.1
      DCS=DCS+CSUM(ICL+1)
      IF (CST.GT.DCS) GO TO 100
      CLNU=CLNU+.1*(CST+CSUM(ICL+1)-DCS)/CSUM(ICL+1)
110   CLNU=(FLOAT(IFIX(CLNU*100.)))/100.
      RETURN
120   CLNU=.8
      RETURN
      END
```

TIM.

```
      FUNCTION TIM (T8J)
C
C     RTN TO DEVELOP TIMELINESS FUNCTION
C
      TIM=0.
      IF (T8J.GE.2.) RETURN
      IF (T8J.GT.1.5) GO TO 100
      IF (T8J.GT..5) GO TO 110
      TIM=2.*T8J
      RETURN
100   TIM=4.-2.*T8J
      RETURN
110   TIM=1.
      RETURN
      END
```

SORT.

```
      SUBROUTINE SORT (XIN,XOUT,LIST,N,DECEND)
C
C     RTN TO ORDER ARRAY OF NUMBERS IN ASCENDING OR DESCENDING PRDER
C
      LOGICAL DECEND
      DIMENSION XIN(N), XOUT(N), LIST(N)
      LIST(1)=1
      XOUT(1)=XIN(1)
      DO 150 I=2,N
      IF (XIN(I).LE.XOUT(I-1)) GO TO 140
      IT=I-2
      IF (IT.EQ.0) GO TO 110
      DO 100 K=1,IT
      L=I-K-1
      IF (XIN(I).LE.XOUT(L)) GO TO 120
100   CONTINUE
110   L=0
120   MS=L+2
      DO 130 M=MS,I
      ISUB=I+MS-M
      XOUT(ISUB)=XOUT(ISUB-1)
130   LIST(ISUB)=LIST(ISUB-1)
      XOUT(L+1)=XIN(I)
      LIST(L+1)=I
      GO TO 150
140   XOUT(I)=XIN(I)
      LIST(I)=I
150   CONTINUE
C
C          CHANGE ORDER FROM DESCENDING TO ASCENDING.
C
      IF (DECEND) RETURN
      N2=(N+1)/2
      DO 160 I=1,N2
      A=XOUT(I)
      ISUB=N+1-I
      XOUT(I)=XOUT(ISUB)
      XOUT(ISUB)=A
      IA=LIST(I)
      LIST(I)=LIST(ISUB)
160   LIST(ISUB)=IA
      RETURN
      END
```

FINAL.

```
      SUBROUTINE FINAL
C
C     RTN TO PREP AND WRITE FINAL RPT AND TECH PROFILES
C
      COMMON /EX/ BUDG(5),DOFAC,DOREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CEN
     1G,LASTY
      COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),
     1              CSUM(8),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),
     2              LIM(5),NPH(14,28),RWU(10),S(15),T(15),
     3              TG(117)
      COMMON /FIVE/ CLY(250,6),ITP(250),LR(250,5),PER(250),
     1              TBJ(16),TGK(117)
      LOGICAL DOFAC,DOREP,DOPRO,DORL1,DORL2
      DIMENSION IHRS(5), CAS(8), ENC(8), ENI(8)
      DIMENSION CSO(5),ECO(5),EIO(5),IPRO(250,15),IROW(80),IYAR(6),
     1          TJO(15),TKO(15),ITC(2),ISY(2),
     2          NAMP(4),NAMT(4),IFAC(6,8),OCC(6,8),TS(15),TT(15)
      DATA IBLNK,(IYAR(I),I=1,6)/1H ,1H8,1H9,1H0,1H1,1H2,1H3/
      DATA ITC(1)/12H2    TECH OBJ/,ISY(1)/12H1SYS SUPPORT/
      WRITE (8,320)
      DO 200 I=1,NT
      READ (1) ITASK,NAMT,ISYM,LEXT,NAMP,LIM,IR,(ITITLE(J,I),J=1,8),CS,E
     1C,BI,CLH,CSH,IT,T,IS,S,RWU,CAS,ENC,ENI,IFAC,OCC
C
C     WRITE FINAL RPT
C
      IF (MOD(I,2).EQ.1) WRITE (6,260) IDT
      ID=ITASK/100000000
      WRITE (6,270) ID,ITASK,(ITITLE(J,I),J=1,8),IR
      DO 100 J=1,15
      IG=IT(J)
      TKO(J)=0
      IF (IG.NE.0) TKO(J)=TGK(IG)*.001
      IB=IS(J)
      TJO(J)=0.
      IF (IB.NE.0) TJO(J)=TBJ(IB)*.01
      TT(J)=FLOAT(IT(J))*.001
      TS(J)=FLOAT(IS(J))*.01
  100 IF (DOPRO) IPRO(I,J)=IFIX(10.*S(J)+.01)+100*IB+100000*IFIX(10.*T(J
     1)+.01)+10000000*IG
      WRITE (6,280) TT,TS,T,S,TKO,TJO
      DO 110 J=1,5
      CSO(J)=0.
      ECO(J)=0.
  110 EIO(J)=0.
      DO 120 J=1,LASTY
      IF (ABS(CLY(I,J+1)-CLY(I,J)).LT..0001) GO TO 120
      PCT=1.
      IF (CLY(I,J+1).GT..799) PCT=PER(I)
      NRL=LR(I,J)
      CSO(J)=CS(NRL)*PCT
      ECO(J)=EC(NRL)*PCT
      EIO(J)=EI(NRL)*PCT
  120 CONTINUE
      WRITE (6,290) CLH,(CLY(I,J),J=2,6),(RWU(J),J=1,5),CSH,CSO,(RWU(J),
```

```
          FNAL.
     1J=6,10),ECC,EIO,(LR(I,J),J=1,5)
C
C     CHECK FOR TASKS NOT SELECTED FOR 5 YEARS
C
      IF (ABS(CLY(I,1)-CLY(I,6)).GT..0001) GO TO 130
      WRITE (8,330) ITASK,(ITITLE(J,I),J=1,8)
      GO TO 200
130   IF (.NOT.DOFAC) GO TO 200
C
C     WRITE FACILITY PRE-SORT BINARY RECORDS
C
      JS=ABS(CLY(I,1))*10.001
      JT=ABS(CLY(I,6))*10.001
      DO 190 J=JS,JT
      DO 190 K=1,6
      IFC=IFAC(K,J)
      IF (IFC.EQ.0) GO TO 190
      DO 140 L=1,5
140   IHRS(L)=0
      MCLB=J
      DO 180 L=1,5
      MCL=ABS(CLY(I,L+1))*10.001
      IF (MCL.LE.MCLB-1) GO TO 180
      DO 170 M=MCLB,MCL
      DO 150 N=1,6
      IF (IFC.EQ.IFAC(N,M)) GO TO 160
150   CONTINUE
      GO TO 170
160   IHRS(L)=IFIX(OCC(N,M)+.95)+IHRS(L)
170   IFAC(N,M)=0
180   MCLB=MCL+1
      WRITE (11) IFC,ITASK,NAMT,LEXT,IHRS
190   CONTINUE
200   CONTINUE
C
C     WRITE TRAILER
C
      IFC=-9999
      WRITE (11) IFC,ITASK,NAMT,LEXT,IHRS
      IF (.NOT.DOPRO) RETURN
C
C     WRITE PROFILE RPT
C
      DO 250 J=1,131
      J1=J-117
      IF (J.LE.117) WRITE (6,300) ITC,J,IDT
      IF (J.GT.117) WRITE (6,300) ISY,J1,IDT
      DO 250 I=1,NT
      DO 210 K=1,15
      KPRO=IPRO(I,K)+11700
      IF (J.LE.117) KPRO=KPRO/100000
      IF (J.EQ.MOD(KPRO,100000)/100) GO TO 220
210   CONTINUE
      GO TO 250
220   DO 230 M=20,80
230   IROW(M)=IBLNK
```

```
          FNAL.

      DO 240 L=1,6
      KL=7-L
      IL=ABS(CLY(I,KL)*100.)+.01
240   IROW(IL)=IYAR(KL)
      SUP=.1*FLOAT(MOD(KPRD,100))
      IF (SUP.GT..699) WRITE (6,310) ITP(I),SUP,(ITITLE(K,I),K=1,8),(IRO
     1W(K),K=20,80)
250   CONTINUE
      RETURN
C
260   FORMAT (1H138X50HRDE  FY  1969   FINAL  REPORT
     1 30X2A6)
270   FORMAT (1H28HDIVISION13,7X4HTASK2XI8,6X8A6,20X2HARI4//)
280   FORMAT (20X23HSUPPORT  OF  TECH  OBJS42X20HSUPPORT  OF  SYSTEMS/5H
     1 TO  15(1XF3.3),5X4HSYS 15(1XF2.2)/5H SUP 15(3H  .F1.1),5X4HSUP 15
     2(2H .F1.1)/5H TK  15(1XF3.3),5X4H TJ 15(1XF2.2)///)
290   FORMAT (51X7HHISTORY49X16HASSOCIATED  1498/15X2H658X2H668X2H678X2H
     1688X2H698X2H703X2H718X2H728X2H7314X11HWORK  UNITS/4X3HCL 9(7XF3.2)
     2,7X5A6/3X4HC+S 9F10.1,7X5A6/3X4HENGC40X5F10.1/2X5HENGIH40X5F10.1/4
     3X3HRL 38X5I10/2(1H0/))
300   FORMAT (2A6,I4,40X18HFY  1969  PROFILES44X2A6//3X4HTASK7X3HSUP23X5
     1HTITLE43X17HCONFIDENCE LEVEL /70X2H 29(1H.)1H39(1H.)1H49(1H.)1H59(
     21H.)1H69(1H.)1H79(1H.)1H9//)
310   FORMAT (2XI8,4XF3.1,3X8A6,3X61A1)
320   FORMAT (1H146X39HTASKS  NOT  SELECTED  FOR  FIVE  YEARS //)
330   FORMAT (20XI8,12X8A6)
      END
```

UTM40

```
$IBLDR UTM40              16 APR 68                                  UTM40000
$FILE  UTM40   'UNIT01',A(1),READY,BIN,INOUT,BLK=260                 UTM40001
$FILE  UTM40   'UNIT07',A(2),READY,BIN,INOUT,BLK=260                 UTM40002
$FILE  UTM40   'UNITC8',A(3),READY,BCD,INOUT,BLK=22                  UTM40003
$FILE  UTM40   'UNIT11',K(1),READY,BIN,INOUT,BLK=260                 UTM40004
```

```
$IBSYS
$EXECUTE        SORT
      OPTION,EQUALS,MAP,CARDS,TAPES
      CHANNELS,INPUT/K1,MERGE/(B,C),OUTPUT/J3
      FILE,INPUT/1,BLO/13,MODE/B
      FILE,OUT,BLO/13,MODE/B
      REC,FIELD/(36B,36B),LEN/(13)
      SORT,FILE/1,ORD/3,FIELD/(2)
      END
$IBSYS
```

FACT.

```
C     RTN TO O/P SORTED FACILITY UTILIZATION DATA
C
      DIMENSION  ITITLE(11,150)
      DIMENSION IHRS(5),NAMT(4),IHT(5),IDT(2),IHDR(5,5)
      DATA FIRST/T/
      DATA (IHDR(1,I),I=1,5)/
     1                            30HAFFDL-EXISTING FACILITIES      ,
     2                            30H                               ,
     3                            30HAFFDL-PROPOSED FACILITIES      ,
     4                            30HCOMPUTER FACILITIES            ,
     5                            30HNON-AFFDL FACILITIES           /
      LOGICAL FIRST
      CALL DATE (IDT)
C
C     BRING IN FAC TITLES
C
      DO 100 I=1,150
      READ (5,260) (ITITLE(J,I),J=1,11)
      IF (ITITLE(1,I).EQ.0) GO TO 110
100   CONTINUE
      WRITE (6,270)
      STOP
110   READ (3) IFC,ITASK,NAMT,LEXT,IHRS
      IF (IFC.EQ.IFCP) GO TO 180
      IFCP=IFC
      IF (.NOT.FIRST) GO TO 120
      FIRST=.FALSE.
      GO TO 130
120   WRITE (6,240) IHT
      IF (IFC.GT.0) GO TO 130
C
C     TRAILER
C
      WRITE (6,250)
      STOP
C
C     A FAC HDR OR FAC CHANGE
C
130   IFH=IFC/1000
      IF (IFH.EQ.0) IFH=1
      IF (IFH.EQ.IFHP) GO TO 140
      IFHP=IFH
      WRITE (6,200) (IHDR(J,IFH),J=1,5),IDT
      WRITE (6,210)
C
C     SCAN FOR FAC TITLE SUBSCR
C
140   DO 150 I=1,150
      IF (IFC.EQ.ITITLE(1,I)) GO TO 160
150   CONTINUE
160   IFT=ITITLE(1,I)+10000
      WRITE (6,220) IFT,(ITITLE(J,I),J=2,11)
C
C     ZERO SUMS
C
```

```
          FACT.

      DO 170 I=1,5
170   IHT(I)=0
C
C     PRCOESS DETAIL LINE
C
180   DO 190 I=1,5
190   IHT(I)=IHT(I)+IHRS(I)
      WRITE (6,230) ITASK,NAMT,LEXT,IHRS
      GO TC 110
C
200   FORMAT (1H15A6,40HRDE  1969  FACILITY  UTILIZATION  REPORT50X2A6//
     1)
210   FORMAT (1H077X24HHOURS - BY  FISCAL  YEAR/67X2H698X2H708X2H718X2H7
     128X2H73//)
220   FORMAT (1XI4,3X10A6)
230   FORMAT (1XI8,7X5A6,14X5I10)
240   FORMAT (1H047X12HTOTAL  HOURS5I10///)
250   FORMAT (4H1EOJ)
260   FORMAT (I4,9A6,A2)
270   FORMAT (20H0TOO MANY FAC TITLES)
      END
```

APPENDIX I

PROJECT RDE FY 69 PROGRAM - TIME CHARGE NO. 77601

DEPARTMENT OF THE AIR FORCE
AIR FORCE FLIGHT DYNAMICS LABORATORY (AFSC)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO ATTN OF: FDG

15 AUG 1967

SUBJECT: Project RDE FY 69 Program - Time Charge Nr. 77601

TO: FDC FDD FDF FDM FDT

1. Attached are the input data instructions for the FY '69 Research and Development Effectiveness (RDE) Program.

2. The inputs required to RDE have been considerably simplified and reduced as compared to previous years. The engineer's time required will be minimized. There are 4 forms to be completed by the engineer. These are:

Format I - Confidence Level Work Description and Resources Requirements (This is the core of the Project/Task/Subtask Exploratory Development Plan)

Format II - Support of Laboratory Technical Objectives (Internal Laboratory Technical Communication)

Format III - Systems Payoff List. (For communication to SPO and advanced systems offices)

Format IV - Limited War Support. (Used for SEA reporting)

3. The RDE FY '69 Punch Card Transcript will be accomplished by secretarial or clerical personnel who will be specially instructed by FDP to do this task. This will free the engineer of a rather tedious job and will make for consistent entries. Further communications to the Division will be made regarding this matter.

4. The Resource Schedule Summary Work Sheet, Confidence Level Display Chart and Facility Grid Transcript used last year have been deleted from the input requirements.

5. The objectives of above changes are to:

- Minimize engineer's time expended preparing inputs.
- Improve inputs - fewer errors and misinterpretations.
- Improve input data response time.
- Reduce computer usage time.

6. The Laboratory management uses data derived from the RDE outputs throughout the year for information retrieval, as an aid to Laboratory management decisions and for communication with advanced system offices.

7. In view of the above and to assure accuracy, it is extremely important that task engineers have a thorough understanding of the RDE instructions. Instructions should be reviewed prior to actual preparation of RDE input data. Also, a completed sample input package is included for guidance and reference. Use of prior year input data as a guide where task objective remains unchanged will aid in decreasing input preparation time. If further clarification is required, the following FDP personnel are available:

A. B. Nutt, J. F. Schmidt, Lt. L. Morris
Ext. 55337, 52615, Room 2E27, Bldg. 45

8. Each division office is requested to review all the task/subtask inputs and rank these in priority order according to the importance of the effort to future AF systems in general. The rank for each task/subtask will be inserted on the respective Format I prior to forwarding the four formats (I, II, III, & IV) to FDP.

9. Timely integration of inputs by the Plans Office is required. Submittal of Division inputs to FDP in accordance with attached instructions is required on or before 20 November 1967. One (1) typed original of each input format is required.

10. Management judgement is an essential and integral part of the inputs. Careful consideration and review by all echelons is required to ensure that the resulting product will reflect the best professional judgement available in the Laboratory.

DALE D. DAVIS
Colonel, USAF
Director

8 Atch
1. Guidance for FY'69 Resource Levels
2. Guidance on Confidence Level Work Descriptions
3. Format I
4. Format II
5. Format III
6. Format IV
7. Sample Case
8. Flow Chart of RDE '69 Input Prep.

Cy to: FDV

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FY '69 RESOURCE LEVELS

1. Inputs by Laboratory engineers to project RDE for FY 1969 will involve two Resource Levels, namely:

R.L. 1 - Authorized Exploratory Development Engineering Manpower with FY '69 Estimated Budget Dollars
R.L. 2 - Double the Authorized Exploratory Development Engineering Manpower with Dollars Required

2. The resource requirements, which make up these Resource Levels, are described below:

Resource Level 1 - Authorized Exploratory Development Engineering Manpower

The engineering manpower shall be the currently authorized engineering manyears used for exploratory development work. The engineering manyears should be separated into contract engineering manyears and in-house engineering manyears to reflect the best mix suitable for the task and the organization involved. Assume adequate technician, clerical and wage board support is available but do not include in manpower; use engineering manyears only. Work should not be subdivided to a point where less than .3 engineering manyears/yr. are required. The Project Resources List attached, shows the authorized FY '68 exploratory development S&E manyears by project; use this manyear estimate for FY '69 as a guide. Since increases in S&E manpower are not considered likely, constant manpower ceilings will be used for Resource Level 1 in successive years.

For FY '69 ceiling funds, use the Project Resources List attached as a guide but reflect any known changes to the figures that might presently be in effect.

For estimating support funds, use realistically expected support funds for in-house work. Prior year support funding should be used as a general guide. Include supply and equipment requirements with unit costs of over $2500; travel, telephone and Form 9 requirements are not to be included. Also, consider the use of existing and proposed Laboratory facilities and other facilities outside the Laboratory.

Supplies and equipment support shall be considered as being purchased with contract type 610-680 dollars and the total dollars will be used as the task fund requirements.

Resource Level 2 - Double Exploratory Development Engineering Manpower

Use double the authorized exploratory development engineering manyears for the task/subtask level being submitted in RDE FY '69. If the input is at task level, then the manpower should be double the task authorized manpower. If the input is a subtask, it should be double the manpower allotted to that subtask. The manyears should be separated into

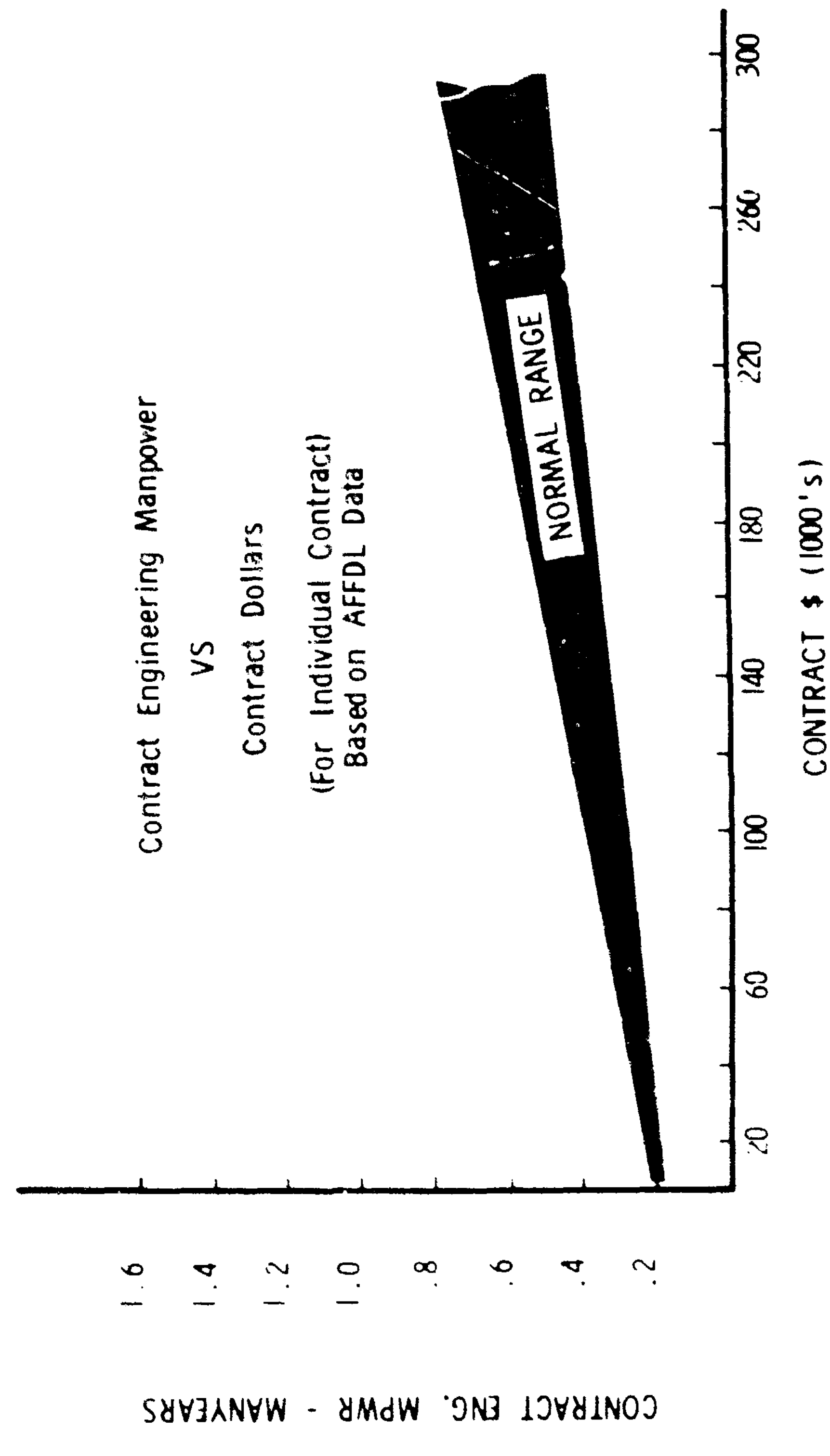
contract engineering manyears and in-house engineering manyears to reflect the best mix suitable for the task and the organization involved. Assume adequate clerical, technician and wage board support is available, but do not include in manpower, use engineering manyears only.

For determining contract funds where experience is not available, consider the increased manyear allocation and use as a guide the attached graph, "Engineer Manpower vs. Contract Dollars."

For estimating support funds, include supply and equipment requirements over $2500; travel, telephone and Form 9 requirements are to be omitted. Also, consider the use of existing and proposed Laboratory facilities and other facilities outside the Laboratory.

Supplies and equipment shall be considered as being purchased with the contract type 610-680 dollars and the total dollars will be used as the task fund requirements.

3. Based on the above information, the FY '69 resources required should be inserted in the "FY '69 Ceiling Resources Programmed and the Double Engineering Manyrs" spaces provided on the Confidence Level Work Description and Resources Requirements format. (Format #I)


Contract Engineering Manpower
VS
Contract Dollars
(For Individual Contract)
Based on AFFDL Data
NORMAL RANGE
CONTRACT ENG. MPWR - MANYEARS
.2
.4
.6
.8
1.0
1.2
1.4
1.6
CONTRACT $ (1000's)
20
60
100
140
180
220
260
300

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A. CONFIDENCE LEVEL WORK DESCRIPTION GUIDANCE

1. To measure the technical progress of each task, the Confidence Level (C.L.) scale is used. Each task engineer, using the Confidence Level scale definitions included in this attachment, will provide the Confidence Level work descriptions for his particular task/subtask.

2. The Confidence Level scale has a range from .2 to 1.0, and each numerical value within the scale is a Confidence Level. To provide consistency among tasks, the Confidence Level definitions shown on the attached sheet are provided for guidance to the engineer.

3. The exploratory development work necessary to achieve the various sequential Confidence Levels shall be described on the format entitled: "Confidence Level Work Description and Resources Requirements", Format I. (See attached completed example) The work descriptions preparation shall be guided by the following comments.

a. Do not show work descriptions at Confidence Levels lower than the current state-of-the-art. If, for example, current state-of-the-art is at Confidence Level .5, then it is not necessary to describe the work conducted to achieve this level. Describe only the work necessary to achieve .6, .7, .8, .9, and 1.0. Do not use partial Confidence Levels such as .63, .72, .75, etc. Also, do not skip Confidence Levels, i.e., if a C.L. is not involved, insert it, and state, no work required. A task/subtask shall be considered to be at a C.L. of .2 which is considered the origin or start point for a new task. The historical information on C.L. and dollars expended for each task/subtask will be inserted on Format I. This information for prior FY's ('64, '65, '66, & '67) is the same as was submitted in RDE '68 inputs. A copy of these basic inputs will be provided to each project engineer. The entry for FY '68 will be the best estimate of C.L. and dollers expended by end of FY '68.

b. Where applicable, include after the description of work necessary, the facilities needed to attain the Confidence Level indicated. The existing and proposed FDL facilities and other outside facilities required, including the occupancy time, should be entered on the Format I, Reference List of Facilities, attached. Notice that the facilities have been coded to aid in data retrieval. Use the coded facility number on the format. (Contact Mr. Frank Nevius, 55337/52615, for code numbers of those facilities not listed.) For example, if in-house structural tests are required to achieve a C.L. of .5, simply enter the code number 0500 for Structural Test Facility, and number of occupancy hours required. Occupancy hours is defined as the period of time the test facility is occupied and precludes the use of the test facility for any other program.

4. The total task resources required to accomplish the work described for each defined C.L. should be estimated and recorded on the Confidence Level Work Description, Format I. This should be the best estimate the

A. CONFIDENCE LEVEL WORK DESCRIPTION GUIDANCE (Cont'd)

task engineer can make without regard to the ceiling resources. This will indicate what it will cost in dollars and engineering manyears to do the various bits of work described for each defined Confidence Level. The total funds will include contract funds and support funds. It is not necessary to separate these funds, since the support fund requirement will be assumed to be provided from the project funding. The engineering manyears should show the breakout of engineering manyears for monitoring contract work and engineering manyears for in-house work. Estimate the resources required based on your presently used mix on in-house to contract manyears.

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CONFIDENCE LEVEL SCALE DEFINITIONS

1.0 The current technology is adequate in all respects; detailed design criteria is established.

.9 The current technology is adequate but minor refinements are desirable.

.8 Feasibility has been demonstrated and the current technology is adequate to solve major problems, but improvements in such areas as service life, reliability and efficiency are needed.

.7 Basic design criteria are available, but extensive testing is required to demonstrate actual feasibility (an Advanced Development Program might be required at this point).

.6 Preliminary design criteria are available but a design at this point would be shaky using only the current information.

.5 A complete exploratory development program, which has a high possibility of successful completion using the most promising approach, is defined.

.4 The most promising approach to solution is indicated through exploratory experimentation, analytical effort, and/or simulation.

.3 Preliminary analysis indicates the potential usefulness of the idea and feasible approaches to the problem.

.2 The problem can be defined, and basic idea(s) formulated, but only general approaches to solution are definable.

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B. SUBTASK IDENTIFICATION GUIDANCE

1. The basic division of work is by task. The task may support one or more systems and Technical Objectives (T.O.'s). The contribution of the task to the systems may vary for different systems. Similarly the contribution to the various T.O.'s may vary. This would be for a standard or normal task. All tasks used in RDE, will be real tasks and not blanket tasks using unauthorized task numbers.

2. Where task resources (manyears and funds) can be divided between subtasks, to reflect contributions to different systems and Technical Objectives, separate subtask Confidence Level work descriptions and resource requirements (Format I) will be prepared.

3. These subtasks will be identified with -1, -2, -3, etc. These subtask (-) numbers will be used for the life of the subtask and once the effort is completed or terminated, the (-) number should not be used again. Contributions of these subtasks to various systems and T.O.'s are handled as with the normal or standard task.

4. The exploratory development engineering manyears for any one subtask in FY69 shall not require less than a total of .3 engineer manyears per year, based on the currently authorized manpower.

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LIST OF TECHNICAL FACILITIES

CODE NR	FACILITY DESCRIPTION
	I AFFDL EXISTING FACILITIES
	NOTE: AFSC Facilities listed below were extracted from AFSCP 80-3 "Technical Facility Capability Key"
0100	Wind Tunnel, Hypersonic (Gas-Dynamic - 50 MW)
0101	MHD Research Tunnel
0200	Wind Tunnel, Hypersonic (Gas-Dynamic - 4 MW)
0300	Wind Tunnel, Supersonic (Gas-Dynamic - 2 Ft)
0400	Wind Tunnel, Hypersonic (Gas-Dynamic - Pebble Bed)
0500	Structures Test Facility (Aerospace Vehicles)
0501	Induction Heating (RF) Facility
0502	Structures Test Sensor Development Facility)
0503	Heavy Gas Gun Facility
0504	Flight Loads Environmental Facility
0600	Environmental Research Laboratory
0601	Natural Environment Laboratory
0602	Induced Environment Laboratory
0700	Flight Control Simulation Facility (Bldg 192)
0701	Control System Development Facility (Bldg 195)
0800	Landing Gear Test Facility
0900	Decelerator Research Laboratory
0901	Wind Tunnel, Vertical
0902	Wind Tunnel, Subsonic
0903	Water Tow Table
0904	Crew Station Development Laboratory
1000	Bearing Research Laboratory (Aircraft)
1100	Cancelled
1200	Atmosphere Control Laboratory
1300	Environmental Control Laboratory
1400	Structural Dynamics Laboratory (Aerospace Veh)
1401	Runway Profilograph

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CODE NR	FACILITY DESCRIPTION (Cont'd)
	I AFFDL EXISTING FACILITIES (Cont'd)
1500	Sonic/Acoustical Vibration Facility (Mobile)
1600	Flight Dynamics Data Analysis Facility
1700	Flight/Navigation Radioisotope Laboratory
1800	Flight Research Simulation Facility
1900	Sonic Fatigue Facility
1901	Sonic Fatigue Chamber (Large)
1902	Sonic Fatigue Chamber (Small)
1903	Noise Facility (Wide Band)
1904	Acoustic Facility (High Intensity)
	II AFFDL PROPOSED FACILITIES
3001	Flight Dynamics Research Laboratory
3002	Combined Environments Laboratory
3003	Facility Engineering Laboratory - Bldg 254
3004	Aerodynamic/Aerothermodynamic Hi Perf Shock Tunnel
3005	Vibration Aeroelasticity Facility
3006	Support & Restraint System Variable Acceleration Evaluator
3007	Landing Gear Model Dynamic Test Facility
3008	50 MW Magentohydrodynamic Augmentation
3009	Grappling & Lock-On Vibration Laboratory
3010	Liquid Hydrogen Test Facility - Structures
3011	50 MW EGF Contoured Nozzles
3012	Sonic Fatigue Facility Noise Source Augmentation
	III COMPUTER FACILITIES
4001	Bldg 45 - Remote Station IBM 1440
4002	Bldg 65 - CDC 1604
4003	Bldg 254 - CDC 160A
4004	50 Megawatt - Ambilog
4005	Bldg 434 - MARK II
4006	Bldg 192 - Simulator
4007	Sonic Fatigue - Analog
4008	Bldg 26 - Supersonic 2' Tunnel
4009	Bldg 45A - FDFE - Data Collection
4010	Bldg 45 - FDCC - Analog
4011	Bldg 57 - Digital (SESCD)
4012	Bldg 57 - Analog (SESCA)

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CODE NR	FACILITY DESCRIPTION (Cont'd)
	IV NON-AFFDL FACILITIES
5010	Aerospace Med Res Laboratory
5011	Sixmode
5012	Drop Tower
5013	Centrifuge
5020	AFIT Facilities
5021	5' Low Speed Tunnel
5022	Nuclear Test Facility
5030	Systems Engineering Group Facilities
5040	Aeronautical Systems Division Facilities
5041	Flight Test Support Facility
5050	Arnold Engineering Development Center
5051	Wind Tunnel - 16' Transonic
5052	Wind Tunnel - 16' Supersonic
5053	Wind Tunnel - VKF - 40" Supersonic (A)
5054	Wind Tunnel - VKF - 50" Mach 8 (B)
5055	Wind Tunnel - VKF - 50" Mach 10 (C)
5056	Wind Tunnel - VKF - 12" Supersonic (D)
5057	Wind Tunnel - VKF - 100" Hypervelocity (F)
5058	Wind Tunnel - VKF - 1000' Hypervelocity (G) (Range)
5059	Wind Tunnel - VKF - 50" Hypervelocity (H)
5060	Wind Tunnel - VKF - Hyperballistic Impact Range
5061	Wind Tunnel - V/STOL
5090	Air Force Missile Development Center
5091	Test Track Facility
5092	Drone Launch/Test Facility
5093	Daisy Decelerator Facility
5100	Air Force Eastern Test Range
5110	Air Force Flight Test Center
5111	Parachute Test Facility
5120	National Bureau of Standards
5130	University of Minnesota
5131	SSWT
5132	HLT
5140	Air Proving Ground Center
5141	Missile Range Facility
5150	Braunschweig, Germany - Pre-Flight Drop Test Facility

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CODE NR	FACILITY DESCRIPTION (Cont'd)
	IV NON-AFDL FACILITIES (Cont'd)
5160	AF - Navy Data Center (Gov Computer Facility at NYU)
5170	Naval Air Station Lakehurst, New Jersey
5180	AF Special Weapons Center, Kirtland AFB, New Mexico
5190	Princeton Free Flight Facility
5200	AMR/PMR Test Range
5210	North American Aviation, Los Angeles
5220	Cornell Aeronautical Laboratories
5230	National Aeronautical & Space Agency
5231	7 X 10' Subs[illegible]c Tunnel
5232	40 X 80' Subs[illegible]ic Tunnel
5233	12' Transonic [illegible]ressure Tunnel
5234	14' Transonic Tunnel
5235	Langley 8' Transonic Tunnel
5236	Langley 7 X 10' Hi Speed Tunnel
5237	Langley 7 X 10' Low Speed Tunnel
5238	AMES 6' Tunnel
5239	DTW[illegible]
5240	Langley Unitary Tunn[illegible]l

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FORMAT I

CONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS

DATE: ________

Task/Subtask Nr. ________ Title ________________ Related Current 1498 Work Unit Nrs. __ __ __ __ __ __ __ __

Task Engr ________ Symbol ____ Tel. Ext. ____ Project Engr. ________ Ext. ____

Goal: (Be specific and quantitative; Max. Time to complete - 10 years)

Resource Levels	(1) FY 69 Ceiling Resources	(2) Double Engr. Manyrs.*	* Show funds required and the Contract and In-House Engr. Mix when total number Engr. Manyears are doubled.
Total Contract & Support Dollars (1000's)	$	$	
Nr. Engr. Manyrs. Contract Monitoring	MY's	MY's	A.R. ____ Division Office Applicability Ranking of this task based on importance to future A.F. System in general.
Nr. Engr. Manyrs. In-House Work	MY's	MY's	
Total Engr. Manyrs.	MY's	MY's	

Historical Information	FY64	FY[illegible]	FY66	FY67	Latest estimate at end of FY68	Coordination
Confidence Level Achieved	.	.	.	.	.	Br. ____
Dollars Expended	$	$	$	$	$	Div. ____

Description of Work Necessary (Give concise description of the work to raise Confidence from one Level to next)	To Obtain a Confidence Level of (.3, .4 to 1.0)	Resources Required: Funds in $1000's	Resources Required: Engr. Manyrs. for Contract Monitoring	Resources Required: Engr. Manyrs. for In-House	Resources Required: Facilities Code Nr	Resources Required: Facilities Occupancy in Hours

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FORMAT I

CONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS (Cont'd)

Task/Subtask Nr. ______________ Title ______________________________

Description of Work Necessary (Give concise description of the work to raise Confidence from one Level to next)	To Obtain a Confidence Level of (.3, .4 to 1.0)	Resources Required				
		Funds in $1000's	Engr. Manyrs for		Facilities	
			Contract Monitoring	In-House	Code Nr	Occupancy in Hours

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FORMAT II

Project/Task/Subtask Nr. __________

SUPPORT OF AIR FORCE FLIGHT DYNAMICS LABORATORY
FY-69 Technical Objective (T.O.'s)

For each task/subtask, insert the contribution (.1 to 1.0), this effort makes toward the accomplishment of the respective Technical Objectives. The scale that defines the contribution values is attached.

If your task/subtask supports a T.O. at a contribution of .8 or greater, the Technical Objective engineer's coordination should be entered immediately after the contribution value. The purpose of this coordination is to increase Laboratory engineer-to-engineer communication. Basically, this reflects professional courtesy.

CODED RDE T.O. NR.	CONTRIBUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDT			STRUCTURES DIVISION
01		93601	Structural Testing Criteria
02		93602	Thermal Application and Control
03		93603	Turbulence Data Measuring Techniques and Systems
04		93604	Instrumentation for Measuring Structural Response
05		93605	Structural Design for Fiber Reinforced Aircraft Structures
06		93606	Reduction of Aircraft Structural Vulnerability
07		93607	Structural Fastening Techniques
08		93608	Dispersion Strengthened Metal Structures
09		93609	Hyperthermantic Structural Configurations Research
10		93610	Structural Design Concepts for Variable-Geometry Lifting Surfaces for Reentry Vehicles
11		93611	Structural Design Criteria for V/STOL Aircraft
12		93612	Empirical Loads Evaluation, Interpretation, and Analysis
13		93613	Structural Design Criteria for Aerospace Vehicles
14		93614	Structural Analysis Methods
15		93615	Structural Fatigue Analysis Methods
16		93616	Maneuver Loads Dynamic Wind Tunnel Simulation
17		93617	Turbulence Generation System
18		93618	Structures for Hypersonic Vehicles
19		93619	Composite Construction for Flight Vehicle Structures
20		93620	Beryllium Structural Technology

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Project/Task/Subtask Nr. ____________

CODED RDE T.O. NR.	CONTRIBUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDM			FLIGHT MECHANICS DIVISION
21		91801	Low Speed Characteristics of Hypervelocity Vehicles
22		91802	Supersonic Boundary Layer Control
23		91803	Inlet Boundary Layer Analysis
24		91804	Airframe-Inlet-Engine Compatibility
25		91805	Hypersonic Inlets - Supersonic Combustion
26		91806	Hypersonic Inlets - Dual Mode Combustion
27		91807	Hypersonic Boundary Layer Phenomena
28		91808	Flight Mechanics of Re-entry Wake
29		91809	Aerodynamics of Multicomponent Vehicles
30		91810	Aerodynamics of Hypersonic Configurations
31		91811	Aerodynamics of Low Density Flow
32		91812	Effects of Aerodynamic Heating on Hypervelocity Vehicles
33		91813	Vehicle Physiochemical Environments
34		91814	Vehicle Synthesis Program
35		91815	Performance Simulations Application to Vehicle Operations
36		91816	Maneuverability Optimization
37		91817	Aerothermodynamic Testing Techniques
38		91818	Hypervelocity Gasdynamic Simulation
39		91819	Hypervelocity Flow Measuring Techniques
40		91820	Hypervelocity Facility Magnetohydrodynamic Accelerators
41		91821	Improvement of Experimental Prediction Techniques for V/STOL Configurations
42		91822	Aerodynamic Prediction Techniques for V/STOL Aircraft
43		91823	V/STOL Propulsive Aerodynamics
44		91824	Hypersonic Exhaust Nozzles for Supersonic Combustion Ramjet Applications
45		91825	Airframe - Exhaust Nozzle Integration
46		91826	Hypersonic Vehicles
47		91827	Aerospace Vehicle Integration
48		91828	Facilities for Thermal Testing of Re-entry Heat Protection Materials
49		91829	Hypersonic Variable Geometry Configurations
50		91830	Effect of Ablation on Drag
51		91831	Effect of Nose Blunting on Reacting Boundary
52		91832	Turbulent Reacting Flows
53		91833	Fluid Dynamic Drag in Low Density Flows

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Project/Task/Subtask Nr. ___________

CODED RDE T.O. NR.	CONTRI-BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDC			FLIGHT CONTROL DIVISION
54		91701	Control System Analysis, Synthesis, and Optimization Techniques
55		91702	Gravity Gradient Techniques at Synchronous Altitude
56		91703	Flexible Vehicle Dynamic Response Control
57		91704	Aerodynamics of Stability and Control
58		91705	V/STOL Stability and Control
59		91706	Handling Qualities Criteria for Aerospace Vehicles
60		91707	Self-Adaptive and Invariant Flight Control Technology
61		91708	Energy Management Concepts
62		91709	Self-Learning Flight Control Systems
63		91710	Space Vehicle Attitude Control and Stabilization Techniques
64		91711	Integrated Flight Control Systems
65		91712	Flight Control Reliability
66		91713	Aerospace Vehicle Flight Control Actuation Techniques
67		91714	Fluidic/Flueric Control Techniques
68		91715	Control Data System Technology
69		91716	Air-Mass Referenced Data Measurement Techniques
70		91717	Vehicle Attitude and Rate Sensing Techniques
71		91718	Exo-Atmosphere Sensing Techniques
72		91719	Transducers for Vehicle Controls in Severe Environmental Conditions
73		91720	Propellant and Propulsion Energy Management Technology
74		91721	Vector Thrust and Thrust Related Parameter Measurement Technology
75		91722	Propellant Data Measurement Technology
76		91723	Propulsion Performance Assessment and Prediction
77		91724	Radiation Resistant Design Techniques
78		91725	Exploitation of Modern Physics Phenomena for Control Data Measurement
79		91727	Wind Tunnel Simulation of Gust and Maneuver Response and Control
80		91728	Display Mechanization Techniques
81		91729	Improvement of Display Interpretation and Readability
82		91730	Takeoff, Letdown, Approach, & Landing Techniques

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Project/Task/Subtask Nr. ____________

CODED RDE T.O. NR.	CONTRI-BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDC (Cont'd)			FLIGHT CONTROL DIVISION
83		91731	V/STOL Aircraft Control Technology
84		91732	Electrical Primary Flight Control System Techniques
85		91733	Remote Visual Displays
86		91734	Illumination Techniques
87		91735	Primary Flight Controller Design for Transport Aircraft
88		91736	Energy Maneuverability Display Techniques
89		91737	Gas Injection Techniques for Control of Re-entry Vehicles and Interceptors
FDD			VEHICLE DYNAMICS DIVISION
90		93801	Unsteady Aerodynamics
91		93802	Thermoelastic Characteristics of Flexible Structures
92		93803	Dynamic Aerothermoelastic Problems and Criteria
93		93804	Dynamic Load Technology for Aircraft
94		93805	Dynamic Load Technology for Aerospace Vehicles
95		93806	Flight Vehicle Vibration Prediction and Control
96		93807	Dynamic Measurement and Analysis Technology
97		93808	Flight Vehicle Noise Prediction and Control
98		93809	Simulation of High Intensity Noise and Associated Environments
99		93810	High Intensity Acoustic Testing Techniques
100		93811	Sonic Fatigue of Flight Vehicle Structure
101		93812	Sonic Fatigue Instrumentation Development

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Project/Task/Subtask Nr. ___________

CODED RDE T.O. NR.	CONTRI-BUTION OF TASK TO T.C. (.1 to 1.0)	T.O. NR.	TITLE
FDF			AEROSPACE VEHICLE EQUIPMENT DIVISION
102		90401	First-Stage Type Aerodynamic Decelerators
103		90402	Aerodynamic Decelerator Landing Point Control
104		90403	Heavy Equipment and Personnel Airdrop Concepts
105		90405	Emergency Crew Escape
106		90406	Personnel Seating and Restraint Systems
107		90407	Aerospace Vehicle Crew Stations
108		90408	Environmental Simulation, Protection, and Test
109		90409	Vehicle Atmosphere Control
110		90410	Aircraft Thermal Control
111		90411	Space Vehicle Thermal Control
112		90412	Cryogenic Cooling
113		90413	Bearings, Bushings, and Special Components (formerly Bearings for Advanced Systems)
114		90414	Alighting Gear System Concepts and Simulation Techniques
115		90417	Aircrew Rescue Capability
116		90418	Personnel Passive Defense Protection

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Scale for Task/Subtask Contri-
bu:ion to Technical Objective

Potential Breakthrough -------------	1.0
	.9
Major Advancement ------------------	.8
Average Evolutionary Advancement ---- (Steady Progress)	.6
	.5
Refinement or Improvement -----------	.4
	.3
Minor Contribution -----------------	.2
	.1

NOTE: When a Task or Subtask supports a Technical Objective at a contribution of .8 or greater, the Tech Obj engineer's coordination will be obtained.

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FORMAT III

SYSTEMS PAYOFF LIST**

Task/Subtask Nr. ______________ Title ______________________

Engr's Name ____________________ Symbol ________ Tel. Ext. __________

Reports Published Since June 1966 *Indicate after title (C) for Contract & (IH) for In-House	Title* (C) or (IH)	Report Nr.

BRIEF STATEMENT OF CURRENT STATE-OF-THE-ART FOR THIS TASK (4 Lines Max.)

____

____

____

SYSTEM NR. SUPPORTED	CONTRIBUTION OF TASK TO SYSTEM (.1 to 1.0)	PAYOFF - BRIEFLY STATE (2 TO 3 LINES) IN QUANTITATIVE TERMS, THE SPECIFIC IMPROVEMENT THIS TASK PROVIDES EACH SYSTEM BEYOND THE CURRENT STATE-OF-THE-ART

**If the contribution of task to system exceeds .7, show SPO coordination. (Telephone Corrdination is acceptable)

System ____________________ SPO Coordination ______________

5-1

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Instructions for Systems Payoff List Format III

In general, the entries to this form are self explanatory.

a. Note that Technical Reports published should reflect whether it is a Contract or In-House report.

b. Use the attached list of RDE 69 systems to obtain identification code number, i.e., 1, 2, 3, 4, 5 . . . . Enter the RDE FY 69 identification code numbers for the systems supported by this task/subtask. Insert the contribution value based on the attached contribution to system scale. (.1 thru 1.0)

c. Several system numbers may be inserted in one block if the contribution value is the same for each system. (See example)

d. Note that contribution values greater than .7 require the SPO's coordination. Telephone coordination will suffice.

e. Type the requested information on Format III. Do not merely reference prior year form entries.

5-2

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Scale for Task/Subtask Contribution to System

Absolutely Essential -- Failure to have this technology available will prevent initiation of the system acquisition phase	1.0
Major Contribution -- This technology makes such a major contribution to this system that if it is not funded by the laboratory the system office will probably fund it to ensure its availability	.9
Significant Contribution -- Failure to acquire this technology will result in a significant decrease in one or more of the performance parameters of the system	.8
Substantial Contribution --	.7
	.6
Refinement of System Capability --------------------------------	.5
	.4
Indirect Contribution --	.3
	.2
Remote Association --	.1

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The RDE 69 advanced system descriptions are classified and will be provided separately. Each Division office and each project engineer will be furnished a copy.

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Aug. 67

FORMAT IV

Project/Task/Subtask Nr. ________________

I. **Definitions**

Limited War - Armed conflict short of general war, exclusive of incidents, involving the overt engagement of the military forces of two or more nations.

Special Air Warfare - Air Force effort in the following:

a. Counterinsurgency - The entire scope of military, paramilitary, political economic, psychological and civic actions taken by or in conjunction with the government of a nation to defeat insurgency.

b. Unconventional Warfare - Includes the three interrelated fields of guerilla warfare, evasion and escape, and subversion against hostile states. Unconventional warfare operations are conducted within enemy or enemy-controlled territory by predominantly indigenous personnel, usually supported and directed in varying degrees by an external source.

II. **Evaluation Scale**

Specifically Applicable and Primarily Intended for LW/SW	1.0
	.9
	.8
Substantially contributes to the systems normally associated with LW/SW/COIN e.g., V/STOL and HIT Missile, etc.	.7
	.6
	.5
	.4
Indirectly Applicable and not Primarily Intended for LW/SW	.3
	.2
Remotely Associated with LW/SW	.1

Using the above scale and definitions, evaluate the contribution this task/subtask has toward (I) Limited War (LW) and (II) Special Air Warfare (SW). Also, if I or II apply, indicate with an XX which of the 3 other categories (III Interdiction (IN), IV Close Support (CS) and/or V Logistics (LG) are applicable.

Contribution

I. Limited War (LW) ____________
II. Special Air Warfare ____________
III. Interdiction (IN) ____________
IV. Close Support (CS) ____________
V. Logistics (LG) ____________

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Sept. 67

EXAMPLE INPUT

This example is based on an actual input from last year; some values shown were changed to cover all aspects for example purposes

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Aug. 67

FORMAT I

CONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS DATE: 10 Oct. 66

Task/Subtask Nr. 146702-1 Title Thermoelastic Structural Analysis Related Current 1498 Work Unit Nrs. 006 007

Task Engr Gene E. Maddux Symbol FDTR Tel. Ext. 55689 Project Engr. R. Bader Ext. 55551

Goal: (Be specific and quantitative; Max. Time to complete - 10 years)

To develop thermoelastic analysis methods capable of predicting the bahavior of complex structures subjected to severe thermal and load environments.

Resource Levels	(1) FY 69 Ceiling Resources	(2) Double Engr. Manyrs.*
Total Contract & Support Dollars (1000's)	$90	$ 200
Nr. Engr. Manyrs. Contract Monitoring	.4 MY's	.6 MY's
Nr. Engr. Manyrs. In-House Work	.6 MY's	1.4 MY's
Total Engr. Manyrs.	1.0 MY's	2.0 MY's

* Show funds required and the Contract and In-House Engr. Mix when total number Engr. Manyears are doubled.

A.R. 16 Division Office Applicability Ranking of this task based on importance to future A.F. System in general.

Historical Information	FY64	FY65	FY66	FY67	Latest estimate at end of FY68
Confidence Level Achieved	.25	.30	.35	.37	.42
Dollars Expended	$115	$31	$70	$136	$90

Coordination

Br. F.J. Janick

Div. R.F. Hoener

Description of Work Necessary (Give concise description of the work to raise Confidence from one Level to next)	To Obtain a Confidence Level of (.3,.4 to 1.0)	Resources Required: Funds in $1000's	Engr. Manyrs. for Contract Monitoring	Engr. Manyrs. for In-House	Facilities: Code Nr	Facilities: Occupancy in Hours
Best approach to satisfy the need chosen. Testing continues.	.5	100	.4	.6	0500 4011	500 20
Theoretical background and computer programming completed. Testing continues.	.6	200	.8	1.2	0500 4011	250 20

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FORMAT I

CONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS (Cont'd)

Task/Subtask Nr. 146702-1 Title Thermoelastic Structural Analysis

Description of Work Necessary (Give concise description of the work to raise Confidence from one Level to next)	To Obtain a Confidence Level of (.3, .4 to 1.0)	Resources Required				
		Funds in $1000's	Engr. Manyrs for Contract Monitoring	Engr. Manyrs for In-House	Facilities Code Nr	Facilities Occupancy in Hours
Experimental program completed. Check out of computer program continues.	.7	200	.8	1.2	0500 4011	250 20
Final analysis form attained. Minor improvements added.	.8	100	.4	.6	0500 4011	250 20
Distribution of analyses completed. Feedback from users compiled.	.9	100	.4	.6	—	—
Analyses completed in which we have 100% confidence in achieving accuracies of 95% or better in determining the exact thermal stress and deformations in a vehicle.	1.0	100	.4	.6	—	—

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FORMAT II

Project/Task/Subtask Nr. 146702-1

SUPPORT OF AIR FORCE FLIGHT DYNAMICS LABORATORY
FY-69 Technical Objective (T.O.'s)

For each task/subtask, insert the contribution (.1 to 1.0), this effort makes toward the accomplishment of the respective Technical Objectives. The scale that defines the contribution values is attached.

If your task/subtask supports a T.O. at a contribution of .8 or greater, the Technical Objective engineer's coordination should be entered immediately after the contribution value. The purpose of this coordination is to increase Laboratory engineer-to-engineer communication. Basically, this reflects professional courtesy.

CODED RDE T.O. NR.	CONTRIBUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDT			STRUCTURES DIVISION
01	.6	93601	Structural Testing Criteria
02		93602	Thermal Application and Control
03		93603	Turbulence Data Measuring Techniques and Systems
04		93604	Instrumentation for Measuring Structural Response
05	.6	93605	Structural Design for Fiber Reinforced Aircraft Structures
06	.6	93606	Reduction of Aircraft Structural Vulnerability
07		93607	Structural Fastening Techniques
08		93608	Dispersion Strengthened Metal Structures
09	.6	93609	Hyperthermantic Structural Configurations Research
10	.6	93610	Structural Design Concepts for Variable-Geometry Lifting Surfaces for Reentry Vehicles
11		93611	Structural Design Criteria for V/STOL Aircraft
12		93612	Empirical Loads Evaluation, Interpretation, and Analysis
13	.4	93613	Structural Design Criteria for Aerospace Vehicles
14	.9 Bader	93614	Structural Analysis Methods
15	.9 Wood	93615	Structural Fatigue Analysis Methods
16		93616	Maneuver Loads Dynamic Wind Tunnel Simulation
17		93617	Turbulence Generation System
18	.6	93618	Structures for Hypersonic Vehicles
19	.6	93619	Composite Construction for Flight Vehicle Structures
20		93620	Beryllium Structural Technology

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Project/Task/Subtask Nr. 146702-1

CODED RDE T.O. NR.	CONTRI-BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDM			FLIGHT MECHANICS DIVISION
21		91801	Low Speed Characteristics of Hypervelocity Vehicles
22		91802	Supersonic Boundary Layer Control
23		91803	Inlet Boundary Layer Analysis
24		91804	Airframe-Inlet-Engine Compatibility
25		91805	Hypersonic Inlets - Supersonic Combustion
26		91806	Hypersonic Inlets - Dual Mode Combustion
27		91807	Hypersonic Boundary Layer Phenomena
28		91808	Flight Mechanics of Re-entry Wake
29		91809	Aerodynamics of Multicomponent Vehicles
30		91810	Aerodynamics of Hypersonic Configurations
31		91811	Aerodynamics of Low Density Flow
32		91812	Effects of Aerodynamic Heating on Hypervelocity Vehicles
33		91813	Vehicle Physiochemical Environments
34		91814	Vehicle Synthesis Program
35		91815	Performance Simulations Application to Vehicle Operations
36		91816	Maneuverability Optimization
37		91817	Aerothermodynamic Testing Techniques
38		91818	Hypervelocity Gasdynamic Simulation
39		91819	Hypervelocity Flow Measuring Techniques
40		91820	Hypervelocity Facility Magnetohydrodynamic Accelerators
41		91821	Improvement of Experimental Prediction Techniques for V/STOL Configurations
42		91822	Aerodynamic Prediction Techniques for V/STOL Aircraft
43		91823	V/STOL Propulsive Aerodynamics
44		91824	Hypersonic Exhaust Nozzles for Supersonic Combustion Ramjet Applications
45	.5	91825	Airframe - Exhaust Nozzle Integration
46	.5	91826	Hypersonic Vehicles
47		91827	Aerospace Vehicle Integration
48		91828	Facilities for Thermal Testing of Re-entry Heat Protection Materials
49		91829	Hypersonic Variable Geometry Configurations
50		91830	Effect of Ablation on Drag
51		91831	Effect of Nose Blunting on Reacting Boundary
52		91832	Turbulent Reacting Flows
53		91833	Fluid Dynamic Drag in Low Density Flows

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Project/Task/Subtask Nr. 146702-1

CODED RDE T.O. NR.	CONTRIBUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDC			FLIGHT CONTROL DIVISION
54		91701	Control System Analysis, Synthesis, and Optimization Techniques
55		91702	Gravity Gradient Techniques at Synchronous Altitude
56		91703	Flexible Vehicle Dynamic Response Control
57		91704	Aerodynamics of Stability and Control
58		91705	V/STOL Stability and Control
59		91706	Handling Qualities Criteria for Aerospace Vehicles
60		91707	Self-Adaptive and Invariant Flight Control Technology
61		91708	Energy Management Concepts
62		91709	Self-Learning Flight Control Systems
63		91710	Space Vehicle Attitude Control and Stabilization Techniques
64		91711	Integrated Flight Control Systems
65		91712	Flight Control Reliability
66		91713	Aerospace Vehicle Flight Control Actuation Techniques
67		91714	Fluidic/Flueric Control Techniques
68		91715	Control Data System Technology
69		91716	Air-Mass Referenced Data Measurement Techniques
70		91717	Vehicle Attitude and Rate Sensing Techniques
71		91718	Exo-Atmosphere Sensing Techniques
72		91719	Transducers for Vehicle Controls in Severe Environmental Conditions
73		91720	Propellant and Propulsion Energy Management Technology
74		91721	Vector Thrust and Thrust Related Parameter Measurement Technology
75		91722	Propellant Data Measurement Technology
76		91723	Propulsion Performance Assessment and Prediction
77		91724	Radiation Resistant Design Techniques
78		91725	Exploitation of Modern Physics Phenomena for Control Data Measurement
79		91727	Wind Tunnel Simulation of Gust and Maneuver Response and Control
80		91728	Display Mechanization Techniques
81		91729	Improvement of Display Interpretation and Readability
82	.5	91730	Takeoff, Letdown, Approach, & Landing Techniques

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Project/Task/Subtask Nr. 146702-1

CODED RDE T.O. NR.	CONTRIBUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDC (Cont'd)			FLIGHT CONTROL DIVISION
83		91731	V/STOL Aircraft Control Technology
84		91732	Electrical Primary Flight Control System Techniques
85		91733	Remote Visual Displays
86		91734	Illumination Techniques
87		91735	Primary Flight Controller Design for Transport Aircraft
88		91736	Energy Maneuverability Display Techniques
89		91737	Gas Injection Techniques for Control of Re-entry Vehicles and Interceptors
FDD			VEHICLE DYNAMICS DIVISION
90		93801	Unsteady Aerodynamics
91	.4	93802	Thermoelastic Characteristics of Flexible Structures
92		93803	Dynamic Aerothermoelastic Problems and Criteria
93		93804	Dynamic Load Technology for Aircraft
94		93805	Dynamic Load Technology for Aerospace Vehicles
95		93806	Flight Vehicle Vibration Prediction and Control
96		93807	Dynamic Measurement and Analysis Technology
97		93808	Flight Vehicle Noise Prediction and Control
98		93809	Simulation of High Intensity Noise and Associated Environments
99		93810	High Intensity Acoustic Testing Techniques
100		93811	Sonic Fatigue of Flight Vehicle Structure
101		93812	Sonic Fatigue Instrumentation Development

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Project/Task/Subtask Nr. 146702-1

CODED RDE T.O. NR.	CONTRI-BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDF			AEROSPACE VEHICLE EQUIPMENT DIVISION
102		90401	First-Stage Type Aerodynamic Decelerators
103		90402	Aerodynamic Decelerator Landing Point Control
104		90403	Heavy Equipment and Personnel Airdrop Concepts
105		90405	Emergency Crew Escape
106		90406	Personnel Seating and Restraint Systems
107		90407	Aerospace Vehicle Crew Stations
108	.3	90408	Environmental Simulation, Protection and Test
109		90409	Vehicle Atmosphere Control
110		90410	Aircraft Thermal Control
111		90411	Space Vehicle Thermal Control
112		90412	Cryogenic Cooling
113		90413	Bearings Bushings, and Special Component (formerly Bearings for Advanced Systems)
114		90414	Alighting Gear System Concepts and Simulation Techniques
115		90417	Aircrew Rescue Capability
116		90418	Personnel Passive Defense Protection

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FORMAT III

SYSTEMS PAYOFF LIST**

Task/Subtask Nr. 146702-1 Title Thermoelastic Structural Analysis

Engr's Name Gene E. Maddux Symbol FDTR Tel. Ext. 55689

Reports Published Since June 1966 *Indicate after title (C) for Contract & (IH) for In-House	Title* (C) or (IH)	Report Nr.
	"Approximate Structural Analysis Techniques" (C)	AFFDL-TR-66-59
	"Expermental Test Program to Verify Thermal Analysis" (C)	AFFDL-TR-66-67
	"Math. Analysis of Heat Conduction" (IH)	AFFDL-TR-66-16

BRIEF STATEMENT OF CURRENT STATE-OF-THE-ART FOR THIS TASK (4 Lines Max.)

Thermal stresses are determined for small portions of a vehicle by both handbook solutions and large scale digital computer programs. Photoelastic techniques are being employed to visualize stress patterns.

SYSTEM NR. SUPPORTED	CONTRIBUTION OF TASK TO SYSTEM (.1 to 1.0)	PAYOFF - BRIEFLY STATE (2 TO 3 LINES) IN QUANTITATIVE TERMS, THE SPECIFIC IMPROVEMENT THIS TASK PROVIDES EACH SYSTEM BEYOND THE CURRENT STATE-OF-THE-ART
3,4,7,8, 9,10,11	.6	Improved thermal stress analysis techniques will provide more accurate designs and improved life predictions, thus leading to the ability to carry greater payloads with smaller margins of safety.
6	.5	(Same as above)
16	.8**	(Same as above)

**If the contribution of task to system exceeds .7, show SPO coordination. (Telephone Corrdination is acceptable)

System SMV-2 SPO Coordination Maj. Rockheart 6/6/'66

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Aug. 67

FORMAT IV

Project/Task/Subtask Nr. 146702-1

I. Definitions

Limited War - Armed conflict short of general war, exclusive of incidents, involving the overt engagement of the military forces of two or more nations.

Special Air Warfare - Air Force effort in the following:

a. Counterinsurgency - The entire scope of military, paramilitary, political economic, psychological and civic actions taken by or in conjunction with the government of a nation to defeat insurgency.

b. Unconventional Warfare - Includes the three interrelated fields of guerilla warfare, evasion and escape, and subversion against hostile states. Unconventional warfare operations are conducted within enemy or enemy-controlled territory by predominantly indigenous personnel, usually supported and directed in varying degrees by an external sou

II. Evaluation Scale

Specifically Applicable and Primarily Intended for LW/SW . . . . . :

Substantially contributes to the systems normally associated with LW/SW/COIN e.g., V/STOL and HIT Missile, etc. . . . .

Indirectly Applicable and not Primarily Intended for LW/SW . . . .

Remotely Associated with LW/SW . . . .

Using the above scale and definitions, evaluate the contribution thi: task/subtask has toward (I) Limited War (LW) and (II) Special Air Warfare (SW). Also, if I or II apply, indicate with an XX which of t 3 other categories (III Interdiction (IN), IV Close Support (CS) and/ V Logistics (LG) are applicable.

Contribution

I.	Limited War (LW)	.9
II.	Special Air Warfare	.9
III.	Interdiction (IN)	xx
IV.	Close Support (CS)	
V.	Logistics (LG)	xx

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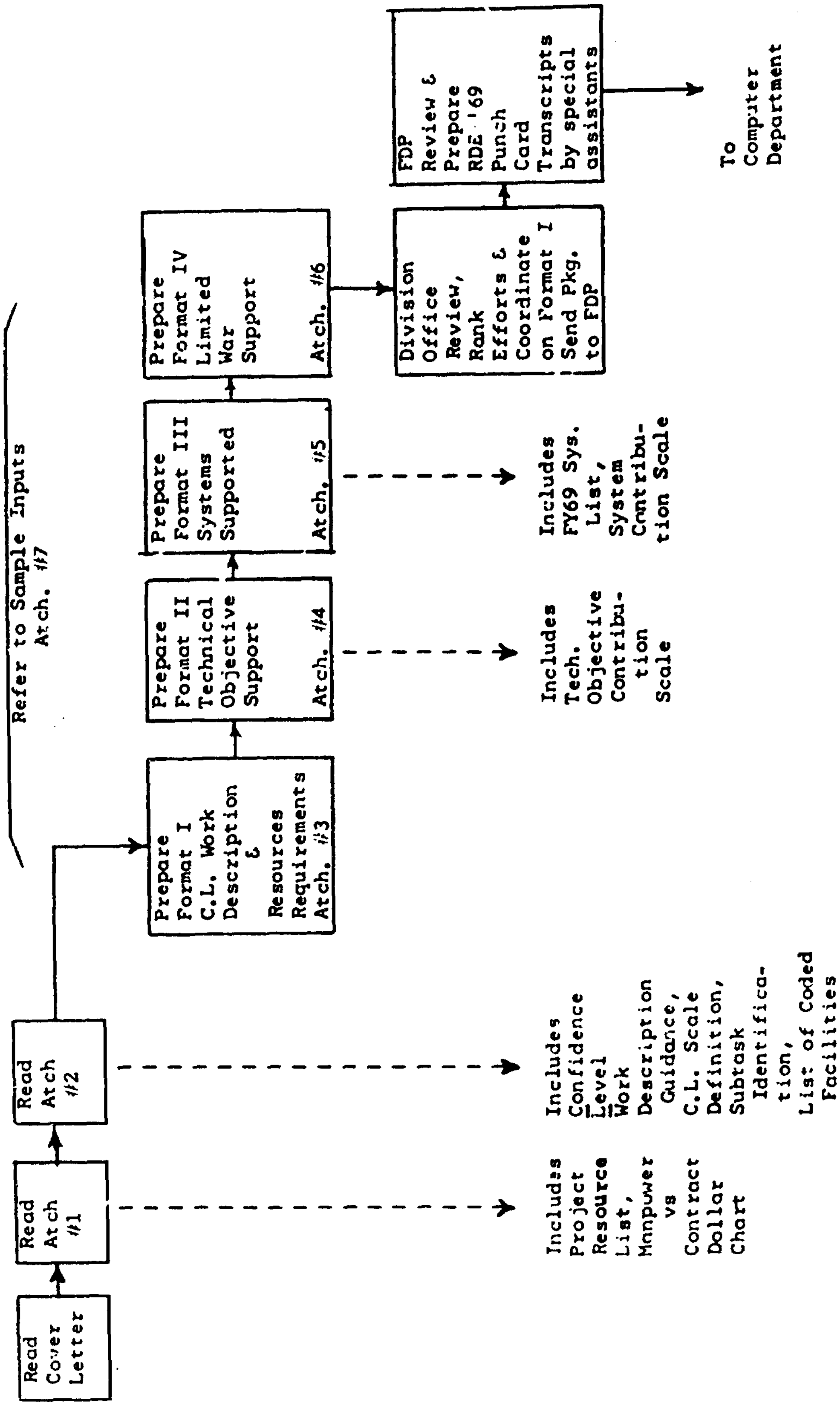
FLOW CHART OF RDE INPUT PREPARATION
(Note all Inputs will be typed)



APPENDIX A

SAMPLE INPUT DATA FOR SPECIFIC TASK

FORMAT I

CONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS

DATE: 10 Nov 19__

Task/Subtask Nr. 134702 Title Measurement of Structural Response Related Current 1498 Work Unit Nrs. 002 003 005 006 007 008 009

Task Engr D. C. Fearnow Symbol FDTE Tel. Ext. 54680 Project Engr. V. E. Kearney Ext. 54680

Goal: (Be specific and quantitative; Max. Time to complete - 10 years)

Develop instrumentation for structural testing of hypersonic vehicles; develop operational fatigue sensors for supersonic vehicles; develop nondestructive inspection techniques for determining the static and fatigue strength of supersonic vehicles.

Resource Levels	(1) FY 69 Ceiling Resources	(2) Double Engr. Manyrs.*
Total Contract & Support Dollars (1000's)	$ 100	$ 325
Nr. Engr. Manyrs. Contract Monitoring	.6 MY's	1.2 MY's
Nr. Engr. Manyrs. In-House Work	3.8 MY's	7.6 MY's
Total Engr. Manyrs.	4.4 MY's	8.8 MY's

* Show funds required and the Contract and In-House Engr. Mix when total number Engr. Manyears are doubled.

A.R. 27 Division Office Applicability Ranking of this task based on importance to future A.F. System in general.

Historical Information	FY64	FY65	FY66	FY67	Latest estimate at end of FY68
Confidence Level Achieved	.2	.2	.3	.4	.5
Dollars Expended (1000's)	$ —	$ 86	$ 93	$ 75	$ 115

Coordination

Br. ________

Div. ________

Description of Work Necessary (Give concise description of the work to raise Confidence from one Level to next)	To Obtain a Confidence Level of (.3, .4 to 1.0)	Resources Required: Funds in $1000's	Engr. Manyrs. for Contract Monitoring	Engr. Manyrs. for In-House	Facilities: Code Nr	Facilities: Occupancy in Hours
1500°F strain sensors adequate; feasibility of 2000°F demonstrated. The most promising approaches for fatigue sensors and nondestructive inspection are indicated.	.6	100	.3	4.1	0500 0502	1000 350

FORMAT I

CONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS (Cont'd)

Task/Subtask Nr. 134702 Title Measurement of Structural Response

Description of Work Necessary (Give concise description of the work to raise Confidence from one Level to next)	To Obtain a Confidence Level of (.3,.4 to 1.0)	Resources Required				
		Funds in $1000's	Engr. Manyrs for		Facilities	
			Contract Monitoring	In-House	Code Nr	Occupancy in Hours
2000°F strain sensor is adequate but needs minor refinements. Preliminary design criteria are available for operational fatigue sensor. Development program for nondestructive inspection is defined.	.7	100	.3	4.1	0500 0502	300 300
2000°F strain sensor is fully adequate. Testing necessary to demonstrate feasibility of fatigue sensor. Preliminary design criteria for nondestructive inspection is available.	.8	100	.3	4.1	0500 0502	1000 700
Adequate technology with some refinements required for this fatigue sensor. Feasibility of nondestructive inspection demonstrated.	.9	100	.3	4.1	0500	2000
Technology adequate in all respects for operational fatigue sensor and nondestructive inspection techniques.	1.0	100	.3	4.1	0500	500

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FORMAT II

Project/Task/Subtask Nr. 134702

SUPPORT OF AIR FORCE FLIGHT DYNAMICS LABORATORY
FY-69 Technical Objective (T.O.'s)

For each task/subtask, insert the contribution (.1 to 1.0), this effort makes toward the accomplishment of the respective Technical Objectives. The scale that defines the contribution values is attached.

If your task/subtask supports a T.O. at a contribution of .8 or greater, the Technical Objective engineer's coordination should be entered immediately after the contribution value. The purpose of this coordination is to increase Laboratory engineer-to-engineer communication. Basically, this reflects professional courtesy.

CODED RDE T.O. NR.	CONTRIBUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDT			STRUCTURES DIVISION
01	.9 W. R. Johnston	93601	Structural Testing Criteria
02	.9 R.A. Noble	93602	Thermal Application and Control
03		93603	Turbulence Data Measuring Techniques and Systems
04	1.0 J.L. Mullineaux	93604	Instrumentation for Measuring Structural Response
05	.8 E. Zink	93605	Structural Design for Fiber Reinforced Aircraft Structures
06		93606	Reduction of Aircraft Structural Vulnerability
07	.9 [illegible]	93607	Structural Fastening Techniques
08	.9 [illegible]	93608	Dispersion Strengthened Metal Structures
09	.9 Nicholson	93609	Hyperthermantic Structural Configurations Research
10	.9 [illegible]	93610	Structural Design Concepts for Variable-Geometry Lifting Surfaces for Reentry Vehicles
11		93611	Structural Design Criteria for V/STOL Aircraft
12		93612	Empirical Loads Evaluation, Interpretation, and Analysis
13		93613	Structural Design Criteria for Aerospace Vehicles
14	.9 [illegible]	93614	Structural Analysis Methods
15	.8 H. Wood	93615	Structural Fatigue Analysis Methods
16		93616	Maneuver Loads Dynamic Wind Tunnel Simulation
17		93617	Turbulence Generation System
18	.9 N.H. [illegible]	93618	Structures for Hypersonic Vehicles
19	.9 N.H. [illegible]	93619	Composite Construction for Flight Vehicle Structures
20	.9 F. Barnett	93620	Beryllium Structural Technology

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Project/Task/Subtask Nr. 134702

CODED RDL T.O. NR.	CONTRI-BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDM			FLIGHT MECHANICS DIVISION
21		91801	Low Speed Characteristics of Hypervelocity Vehicles
22		91802	Supersonic Boundary Layer Control
23		91303	Inlet Boundary Layer Analysis
24		91804	Airframe-Inlet-Engine Compatibility
25		91805	Hypersonic Inlets - Supersonic Combustion
26		91806	Hypersonic Inlets - Dual Mode Combustion
27		91807	Hypersonic Boundary Layer Phenomena
28		91808	Flight Mechanics of Re-entry Wake
29		91809	Aerodynamics of Multicomponent Vehicles
30		91810	Aerodynamics of Hypersonic Configurations
31		91811	Aerodynamics of Low Density Flow
32	.4	91812	Effects of Aerodynamic Heating on Hypervelocity Vehicles
33		[illegible]	Vehicle Physiochemical Environments
34		91814	Vehicle Synthesis Program
35		91815	Performance Simulations Application to Vehicle Operations
36		91816	Maneuverability Optimization
37		91817	Aerothermodynamic Testing Techniques
38		91818	Hypervelocity Gasdynamic Simulation
39	.2	91819	Hypervelocity Flow Measuring Techniques
40		91820	Hypervelocity Facility Magnetohydrodynamic Accelerators
41		[illegible]	Improvement of Experimental Prediction Techniques for V/STOL Configurations
42		91822	Aerodynamic Prediction Techniques for V/STOL Aircraft
43		91823	V/STOL Propulsive Aerodynamics
44		91824	Hypersonic Exhaust Nozzles for Supersonic Combustion Ramjet Applications
45		91825	Airframe - Exhaust Nozzle Integration
46		91826	Hypersonic Vehicles
47		91827	Aerospace Vehicle Integration
48		91828	Facilities for Thermal Testing of Re-entry Heat Protection Materials
[illegible]	.5	91829	Hypersonic Variable Geometry [illegible]
50		91830	Effect of Ablation on Drag
51		91831	Effect of Nose Blunting on Reacting Boundary
52		91832	Turbulent Reacting Flows
53		91833	Fluid Dynamic Drag in Low Density Flows

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Project/Task/Subtask Nr. 134702

CODED RDC T.O. NR.	CONTRI-BUTION OF TASK TO T.C. (.1 to 1.0)	T.O. NR.	TITLE
FDC			FLIGHT CONTROL DIVISION
54		91701	Control System Analysis, Synthesis, and Optimization Techniques
55		91702	Gravity Gradient Techniques at Synchronous Altitude
56		91703	Flexible Vehicle Dynamic Response Control
57		91704	Aerodynamics of Stability and Control
58		91705	V/STOL Stability and Control
59		91706	Handling Qualities Criteria for Aerospace Vehicles
60		91707	Self-Adaptive and Invariant Flight Control Technology
61		91708	Energy Management Concepts
62		91709	Self-Learning Flight Control Systems
63		91710	Space Vehicle Attitude Control and Stabilization Techniques
64		91711	Integrated Flight Control Systems
65		91712	Flight Control Reliability
66		91713	Aerospace Vehicle Flight Control Actuation Techniques
67		91714	Fluidic/Flueric Control Techniques
68		91715	Control Data System Technology
69		91716	Air-Mass Referenced Data Measurement Techniques
70		91717	Vehicle Attitude and Rate Sensing Techniques
71		91718	Exo-Atmosphere Sensing Techniques
72		91719	Transducers for Vehi[illegible] Controls in Severe Environmental Con[illegible]ions
73		91720	Propellant and Propulsion Energy Management Technology
74		91721	Vector Thrust and Thrust Related Parameter Mea[illegible]urement Technology
75		91722	Propellant Data Measurement Technology
76		91723	Propulsion Performance Assessment and Prediction
77		91724	Radiation Resistant Design Techniques
78		91725	Exploitation of Modern Physics Phenomena for Control Data Measurement
79		91727	Wind Tunnel Simulation of Gust and Maneuver Response and Control
80		91728	Display Mechanization Techniques
81		91729	Improvement of Display Interpretation and Readability
82		91730	Takeoff, Letdown, Approach, & Landing Techniques

Project/Task/Subtask Nr. 134702

CODED RDF T.O. NR.	CONTRI-BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDC (Cont'd)			FLIGHT CONTROL DIVISION
83		91731	V/STOL Aircraft Control Technology
84		91732	Electrical Primary Flight Control System Techniques
85		91733	Remote Visual Displays
86		91734	Illumination Techniques
87		91735	Primary Flight Controller Design for Transport Aircraft
88		91736	Energy Maneuverability Display Techniques
89		91737	Gas Injection Techniques for Control of Re-entry Vehicles and Interceptors
FDD			VEHICLE DYNAMICS DIVISION
90		93801	Unsteady Aerodynamics
91	.7	93802	Thermoelastic Characteristics of Flexible Structures
92		93803	Dynamic Aerothermoelastic Problems and Criteria
93		93804	Dynamic Load Technology for Aircraft
94		93805	Dynamic Load Technology for Aerospace Vehicles
95		93806	Flight Vehicle Vibration Prediction and Control
96		93807	Dynamic Measurement and Analysis Technology
97		93808	Flight Vehicle Noise Prediction and Control
98		93809	Simulation of High Intensity Noise and Associated Environments
99		93810	High Intensity Acoustic Testing Techniques
100		93811	Sonic Fatigue of Flight Vehicle Structure
101	.8 W.K. Shilling	93812	Sonic Fatigue Instrumentation Development

Aug. 67

Project/Task/Subtask Nr. 134702

CORR'D RDE T.O. NR.	CONTRI-BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
TDC			AEROSPACE VEHICLE EQUIPMENT DIVISION
102		90401	First-Stage Type Aerodynamic Decelerators
103		90402	Aerodynamic Decelerator Landing Point Control
104		90403	Heavy Equipment and Personnel Airdrop Concepts
105		90405	Emergency Crew Escape
106		90406	Personnel Seating and Restraint Systems
107		90407	Aerospace Vehicle Crew Stations
108		90408	Environmental Simulation, Protection, and Test
109	.6	90409	Vehicle Atmosphere Control
110		90410	Aircraft Thermal Control
111		90411	Space Vehicle Thermal Control
112		90412	Cryogenic Cooling
113		90413	Bearings, Bushings, and Special Components (formerly Bearings for Advanced Systems)
114		90414	Alighting Gear System Concepts and Simulation Techniques
115		90417	Aircrew Rescue Capability
116		90418	Personnel Passive Defense Protection

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FORMAT III

SYSTEMS PAYOFF LIST**

Task/Subtask Nr. 134702 Title Measurement of Structural Response

Engr's Name Dwight O. Fearnow Symbol FDTE Tel. Ext. 52062

Reports Published Since June 1966 *indicate after title (C) for Contract & (IH) for In-House	Title* (C) or (IH)	Report Nr.
	Design and Construction of a Liquid Level Temperature Transducer (IH)	AFFDL-TR-66-179
	Feasibility Study for the Development of a Fatigue Damage Indicator (C)	AFFDL-TR-6_ [illegible]
	Development of a Strain Measuring Standard for Temperatures up to 2500°F (C)	NBS Report 9535

BRIEF STATEMENT OF CURRENT STATE-OF-THE-ART FOR THIS TASK (4 Lines Max.)

Strain measurement to 1500°F maximum under ideal conditions for short periods. Temp measurement to 2800°F long time, 3400°F short time. Surface lab standards to 3000°F. Fatigue damage indicator feasibility shown at room temperature. Deflection transmission to 3500°F.

SYSTEM NR. SUPPORTED	CONTRIBUTION OF TASK TO SYSTEM (.1 to 1.0)	PAYOFF - BRIEFLY STATE (2 TO 3 LINES) IN QUANTITATIVE TERMS, THE SPECIFIC IMPROVEMENT THIS TASK PROVIDES EACH SYSTEM BEYOND THE CURRENT STATE-OF-THE-ART
5,6,7,8,9, 11,13, and 14.	.6	Structural integrity tests for these systems will draw upon the technology of structural response measurement provided by this task. Specially, elevated temperature strain measurements and temperature distribution measurements are required.
10.	.8	The structural integrity program for this system requires reliable, accurate, long term structural response instrumentation being developed under this task. Elevated temperature strain measurement and elevated temperature fatigue sensors are required.
12	.9	Elevated temperature strain, heat flux, temperature, and deflection measurement is essential to the development of this system.

**If the contribution of task to system exceeds .7, show SPO coordination.
(Telephone Coordination is acceptable) System 10 No SPO exists

System 10 and 12 SPO Coordination System 12 Mr. Ksycewski 55427

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FORMAT IV

Project/Task/Subtask Nr. 134702

I. Definitions

Limited War - Armed conflict short of general war, exclusive of incidents, involving the overt engagement of the military forces of two or more nations.

Special Air Warfare - Air Force effort in the following:

a. Counterinsurgency - The entire scope of military, paramilitary, political economic, psychological and civic actions taken by or in conjunction with the government of a nation to defeat insurgency.

b. Unconventional Warfare - Includes the three interrelated fields of guerilla warfare, evasion and escape, and subversion against hostile states. Unconventional warfare operations are conducted within enemy or enemy-controlled territory by predominantly indigenous personnel, usually supported and directed in varying degrees by an external source.

II. Evaluation Scale

Specifically Applicable and Primarily Intended for LW/SW	1.0
	.9
	.8
Substantially contributes to the systems normally associated with LW/SW/COIN e.g., V/STOL and HIT Missile, etc.	.7
	.6
	.5
	.4
Indirectly Applicable and not Primarily Intended for LW/SW	.3
	.2
Remotely Associated with LW/SW	.1

Using the above scale and definitions, evaluate the contribution this task/subtask has toward (I) Limited War (LW) and (II) Special Air Warfare (SW). Also, if I or II apply, indicate with an XX which of the 3 other categories (III Interdiction (IN), IV Close Support (CS) and/or V Logistics (LG) are applicable.

Contribution

I.	Limited War (LW)	.3
II.	Special Air Warfare	.3
III.	Interdiction (IN)	xx
IV.	Close Support (CS)	xx
V.	Logistics (LG)	xx

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Deputy For Engineering Aeronautical Systems Division Wright-Patterson Air Force Base, Ohio	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

RESEARCH AND DEVELOPMENT EFFECTIVENESS PROGRAM 1969 (RDE 69)
A Management Tool To Allocate the Budget of a Research Organization

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (Last name, first name, initial)

Robert R. Jurick
James F. Bittle, II

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
July 1968	141	

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.	ASD-TR-68-23
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. AVAILABILITY/LIMITATION NOTICES

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Deputy For Engineering Aeronautical Systems Division Wright-Patterson AFB, Ohio

13. ABSTRACT

A formulation and digital computer program is presented as a management tool to allocate the budget of a research organization. It has been designed to meet the specific needs of the Air Force Flight Dynamics Laboratory at Wright-Patterson Air Force Base, Ohio, but instructions are included to enable the program to be used by any research organization. The value of a specific research task is defined and an optimization technique is employed to maximize the total value achieved for a given yearly budget constraint of the organization. A maximum of 250 research tasks may be considered. The program performs a yearly optimization for up to five years. It generates a number of reports which indicate the progress of each research task during the given time period and the effect of this progress on other organizational entities.

DD FORM 1473

UNCLASSIFIED
Security Classification

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Optimal Resource Allocation For Research Tasks						
Budgetary Constraint						
Research Task Objective Coefficient						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2*a*. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2*b*. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7*a*. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

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